









THE TEACHER'S MANUAL OF

OBJECT LESSONS

IN

DOMESTIC ECONOMY

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ADAPTED TO MEET THE REQUIREMENTS OF
THE EDUCATION DEPARTMENT

IN THE

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CLASS SUBJECT OF DOMESTIC ECONOMY
AS LAID DOWN IN THE COPE
FOR 1897

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OBJECT LESSONS IN ELEMENTARY SCIENCE; OBJECT LESSONS
FOR INFANTS

VOL. I.

(STANDARDS I. AND II.)



MACMILLAN AND CO., LIMITED.

ST. MARTIN'S STREET, LONDON, W.C.

NEW YORK: THE MACMILLAN COMPANY.

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PREFACE

THE "Object Lessons in Elementary Science" have met with such hearty approval from the Highest Educational Authority, from H.M. Inspectors in all parts of the country, from the Training Colleges, and from the Press, and have been so universally adopted by the teaching profession in public and private schools, both at home and abroad, that Author and Publishers alike have been encouraged to launch a companion series, dealing with the subject of **Domestic Economy**.

Like their predecessors these books are essentially **Teachers' Manuals**, and the lessons in both follow on precisely the same lines as regards arrangement and method of treatment—the guiding principle throughout being "*from the known to the unknown, and that by easy natural stages, so that each step may suggest the next.*" In this way every lesson becomes not merely a vehicle for conveying some specific teaching, but an actual training ground for future observation and deduction on the things which the child meets with in its everyday life.

These Manuals are designed primarily to meet the requirements of the Education Department in the **Class Subject of Domestic Economy**, as laid down in the **Code for 1897**. But it is anticipated that they will have a much wider field of usefulness as handbooks of Object Lessons for Teachers generally, and not for those only who are interested in that particular Class Subject.

In these, as in the companion series, the Author has considered the Teacher as well as the children. His aim

PREFACE

has been to assist as much as possible in **training the young teacher in the Art of teaching.** It is for this reason that the lessons are all written in full,—not to slavishly bind any one, so as to destroy or even weaken her own individuality, but to point out from the first the true logical sequence of each step as she proceeds. The present volume deals only with Standards I. and II., and the Course prescribed by the Code for each of these two stages consists of "*Thirty object lessons on materials used for food, e.g. Flour, Meat, Vegetables, Tea, Coffee, Milk, Fruits, Salt.*" It will be an easy matter to indicate the method of treatment by following the lessons on the first of these articles—Flour.

The usual stereotyped way is to begin with the corn-field—to plough the field, so to speak, to sow the corn, reap it, thresh it, grind the grain into flour, and so at last come to the loaf of bread which the child sees on the table at meal-time. A moment's thought, however, will show that this is absurdly illogical, especially to thousands of town-bred children, who seldom if ever have seen a cornfield.

In the opening lesson here the familiar loaf of bread is introduced, and the children are led to tell all they can of its properties and uses, first from their own observation (*by seeing, handling, and tasting it*), and then by simple experiment. The most natural step from this is to learn something about the materials of which the loaf is made; and hence the second lesson introduces flour, and deals with its properties in precisely the same experimental way. The flour naturally leads back to the grain; the grain to the ear; the ear to the corn-plant, the corn-field, seed-time and harvest, and so the whole story of the loaf of bread is told.

By this mode of treatment the child's interest is aroused from the first, because she is able to find out something for herself; the next step is that she tries to think for herself, and then the rest is comparatively easy.

Milk, butter, cheese, salt—every article indeed—is

treated in exactly the same manner. That is to say, simple observation of the familiar article itself is made to lead the way to enlarged knowledge. It should also be observed that each lesson in Stage I. has its complement in Stage II. The goal to be reached in the first stage is a clear conception of simple facts deduced from observation, without any regard to technical terms. Thus the opening lesson in Stage I. teaches that the crumb of bread is soft and full of holes, like a sponge; that it soaks up water like a sponge. We say bread is **spongy**. The complementary lesson in Stage II., starting from this, treats of the nature of bread as a **porous** and **absorbent** substance; tells the reason why it is so, and compares it with other bodies of a like nature.

The teacher (and more especially the young teacher) should ever remember that no Object Lesson on any subject is worthy of its name, unless it is amply illustrated with the objects themselves; and keeping this in view, the Author ventures to repeat the advice given in the Manuals on Elementary Science, viz., "Never use a picture where the real object can (with a little trouble) be obtained." At the same time, of course, pictures are indispensable with certain subjects; but each teacher should cultivate with the utmost care dexterity in the use of blackboard, chalk, and duster, for these, after all, in a deft hand will make the most graphic pictures.

In conclusion it should be noted that these, the Teachers' "Manuals," are the outcome of the cordial reception which has been given to the already existing **Domestic Science Readers** for the children. They have been prepared in response to the appeal of a large number of Teachers, and it is earnestly hoped that the two will run side by side—the Readers as the natural complement of the Teachers' object lessons.

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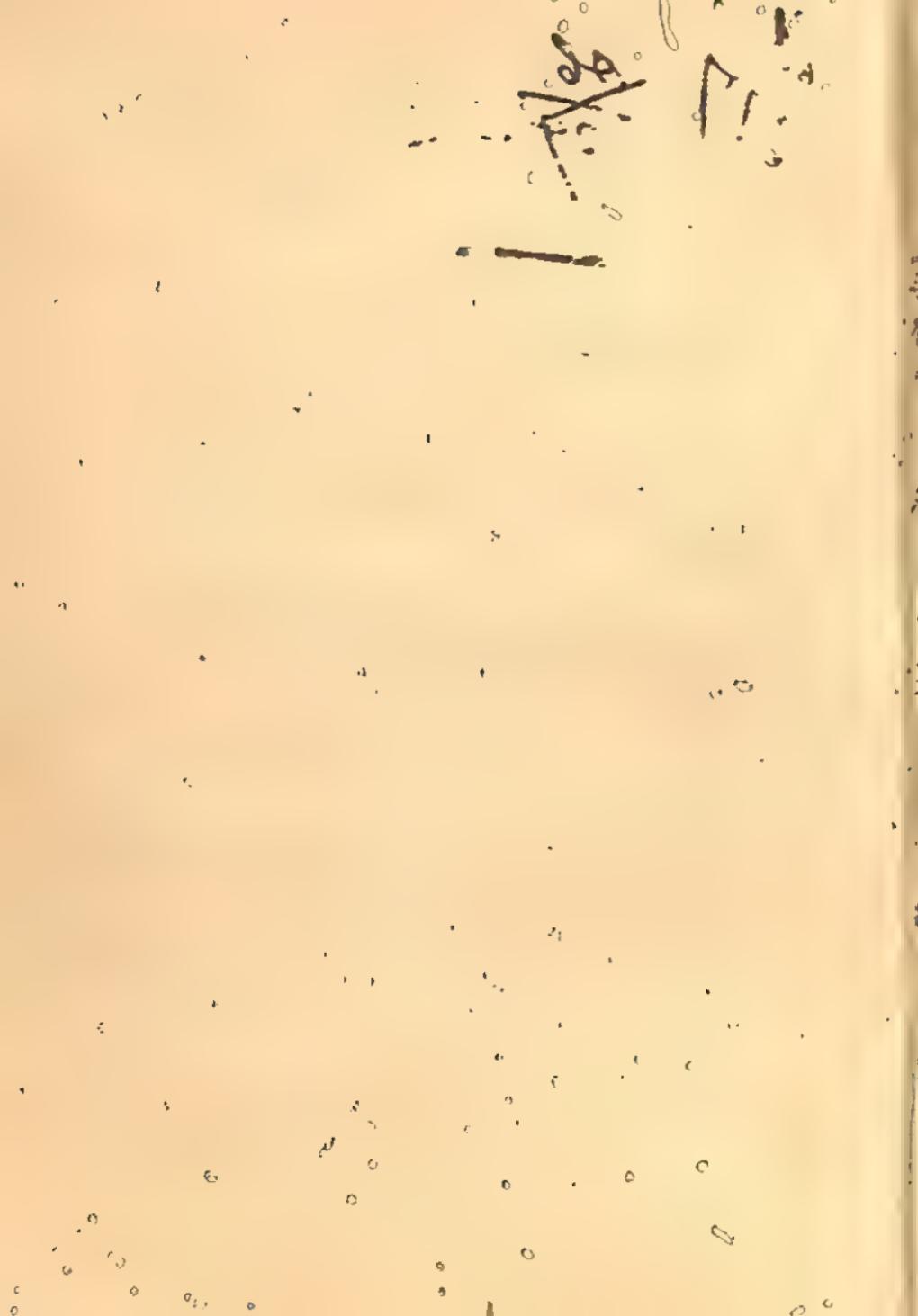
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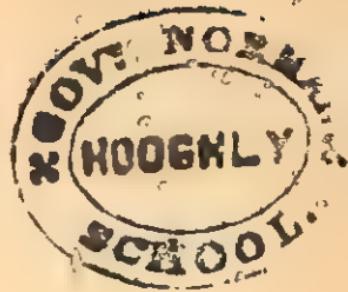
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STANDARD I

Lesson I

OUR FIRST CHAT

Provide for illustration a toy-table and table-cloth, tea-tray and tea-service.

I. THE DAILY MEALS

COMMENCE by leading the children to think about their everyday life at school. They work hard at their lessons all the morning, but although they get a little time between the lessons for play, they are very glad to run away home as fast as they can when school is over.

Why do girls and boys hurry home so quickly? They are glad to get home because they are hungry.

What happens when they get home? Mother gives them their dinner.

How do you yourselves feel after you have had your dinner? We feel better because we are not hungry then.

Yes, you are then ready to play and romp about till it is time to run off to school again, and you can work at your lessons in the afternoon, just as you did in the morning. But what happens by the time afternoon school is over? We get hungry again; we want something to eat.

Explain that it is their work and play which have again made them hungry, and in this way show the need of food. It is our food which keeps us alive; without it we should soon get

ill, and die. But although we must have food, it would be very wrong to eat and drink at all hours of the day, for that too would do us harm.

We take our food at stated times in the day. These we call our **meal-times**; and we call the food which we take at these times our meals.

Call upon the children to tell the names of their daily meals, and lead them to think especially of their morning meal. Picture them as they go to bed at night tired out. Their heads are no sooner on the pillow than they are fast asleep. Their night's sleep rests them, and they wake up in the morning with all that tired feeling gone. Still they are not fit to go to school. They have been without food for many hours; they wake up hungry, and ready for the first meal of the day. To go without food is to fast, and this meal **breaks their fast.** Hence we call it **breakfast.**

Which is the chief meal of the day? **Dinner** is the chief meal; we eat more at dinner-time than at any other meal.

What name do we give to the meal which comes when school is over for the day?

Lead the children to think of **tea-time**—the cosy meal of the day. Lessons are done, and they are free to amuse themselves till bed-time. Picture them when tea is over. In the bright summer weather they have several hours before them to spend in healthy games in the open air. In the dark winter evenings they are quite as happy indoors, with a warm cosy fire, and their books and toys to amuse them.

II. DOLLY'S TEA-TABLE

Produce the toy-table and table-cloth, and have the tea-tray and tea-service ready at hand.

Little girls like to have a tea-party with their dolls and their young friends. They can then make-believe they are mother, take her place at the table, and serve tea. I want you to help me lay Dolly's tea-table now.

What must we do first? We must **lay the cloth.**

What kind of cloth is it? It is a **clean, white cloth**.
Is it always clean? Does it never get dirty? Yes, it gets dirty when it is used.

What must be done with it then? It must be **washed, starched, and ironed**.

How does it look then? It looks white, smooth, and shining again.

Explain that mother always likes to keep her table-cloth clean and white as long as she can. The children can help her to do this by trying to be **careful at the table**. If they are careless and untidy, and spill things on the cloth, it will very soon get dirty.

A dirty table-cloth does not look nice.
Have the table-cloth neatly laid, and then let them tell that the tea-tray will be the next thing wanted.

Now what shall we place on the tea-tray? The **cups and saucers**.

Have them set out on the tray, and explain that there must be a spoon in each person's saucer.

What else do we put on the tea-tray? The **sugar-basin, the cream-jug, and the slop-basin**.

Let these be put in their places, and then explain that the tray is to save the tea, milk, and other things from being spilled on the white cloth.

We drink out of the cup; the saucer is meant to hold the cup. It is not nice to see girls and boys, or any one pour their tea into the saucer, and drink it out of the saucer.

What do we drink out of our cups at home besides tea? At breakfast-time we sometimes have **coffee, or cocoa, instead of tea**.

Yes we do; and for children a cup of **warm milk** would be better than any of these. Tea and coffee are not good for children.

What do we eat with our tea? We eat **bread and butter**, and sometimes **cake, biscuits, jam, and other nice things**.

Quite right. We have had a chat about Dolly's tea-

table, because I wanted you to think of all the things you see on your tea-table at home. We are going to learn something about these things by and by.

Lesson II

A LOAF OF BREAD

The articles required will be two or three specimen loaves of bread, a sponge, some flour, yeast; salt, and a hard dumpling, a knife, a small wooden spoon, a saucer and a basin.

I. PARTS OF A LOAF

PRODUCE the first loaf—a well-baked cottage loaf will be best for the purpose—and commence by leading the children to tell all they can of its parts, and the properties of each part, in some such way as this:—

You see loaves of bread on the table every day of your lives. I want you to look at this one, and tell me all you can about it. What do we call this part of the loaf? **The top of the loaf.**

And this part? That is the **bottom** of the loaf.

What colour is the loaf? **Light brown.**

What do we call this outside part? We call it **the crust.**

Now take the loaf in your hands, and squeeze it, and I think you will learn something else about it. It is **hard**.

Yes, it is hard, but see, I can break off pieces of it with my fingers. What else shall we say about it? It is **brittle** as well as hard.

Next, cut the loaf in halves, and deal in a similar way with the inside.

What name do we give to this inside part? We call it **the crumb.**

This part, you see, is not the same colour as the crust. What can you tell me about its colour? It is **nearly white.**

Look at the crumb again, and see if you notice anything else about it? It is full of little holes.

Give one of the children a piece of the crust in one hand, and a piece of crumb in the other, and ask her to squeeze them. She cannot squeeze the crust because it is hard, but she has no trouble in squeezing the crumb—it is soft?

Yes, the crumb of the loaf is soft and full of little holes. You can squeeze it as easily as I can squeeze this sponge. The sponge, too, is soft, and full of little holes. This is why we sometimes say that the crumb of the loaf is spongy.

Lastly, give them some pieces of the bread to eat, and lead them to tell that it is sweet and pleasant to the taste. Remind them that we eat bread at every meal of the day. Bread, indeed, is such good food, that it would keep us alive if we could get nothing else. Plenty of bread is the best thing to make boys and girls grow big and strong. What a good thing it is that it is so nice to eat! We never get tired of bread.

II. WHAT BREAD IS MADE OF

We are now going to learn what bread is made of. Look at this white powder in the saucer. Do you know what it is? It is flour.

Lead the children to tell that they have often seen mother use this same white powder to make puddings, and pies, and dumplings. Explain that this flour is the principal material used in making bread. Mix a little of the flour with water in a basin, and show that it makes a stiff paste. In making bread we must mix the flour into a paste like this with water.

Bread made of flour and water only would not taste nice. A little salt is sprinkled over the flour before the water is added. The salt gives the bread a nice pleasant taste. So, then, we must have flour, salt, and water to make bread.

Produce the dumpling. Explain that this was made of flour, salt, and water. Cut it open, and let the children com-

pare it with a piece of bread. Lead them to point out that the dumpling is not soft and spongy like the bread; it is **hard**, **tough**, and **close**.

Explain that our bread would be the same if flour, salt, and water alone were used in making it. We say that the dumpling is **heavy**, and bread is **light**. In this way lead them to see that something more is wanted to make the bread different from the dumpling.

Show, if possible, some brewers' yeast, and also a piece of the prepared German yeast. Let the children examine both, and call upon them to notice the peculiar **sour smell**.

The brown-looking froth in the basin and the piece of dry brown cake are the same thing. We call it **yeast**. Look at that in the basin. It is always on the work, **foaming** and **frothing**, and **puffing up**. We put yeast in with the flour, water, and salt to make bread light and spongy. Some day you shall learn what this yeast is, but all I want you to do now is to remember what it does. **Yeast makes bread light and spongy**; without yeast it would be close, tough, and heavy like the dumpling.

III. HOW BREAD IS MADE

It will be quite sufficient at this stage to describe, in a simple sort of way, the method of bread-making, so as to give the children a clear idea of the changes that take place. It is needless to say that, if the conditions were favourable, it would be a great gain to prepare a small loaf in front of the class, and let the children explain, step by step. Where this cannot be done the process must be described.

Salt is sprinkled on the flour. Why?

A hole is made in the middle of the flour, and some yeast, mixed with warm water, is poured into it. Why is the yeast used?

Explain that warm water must always be used in making bread, because cold water would make the bread heavy—the yeast would not work if mixed with cold water.

Describe, either practically or in words, the mixing. This is done by the hands—clean hands.

The materials are worked up, or **kneaded**, in this way, till they make a thick paste, and this is then covered with a cloth and stood in a warm place, and left for some time. At the end of that time the paste is seen to have **puffed up**, and **swollen** to double its size, and if we cut it through we find it **full** of **holes**. We say it has **risen**, and we now call it **dough**.

The dough is afterwards kneaded once more with the hands, and then cut up into pieces, and worked into the shape of a loaf. Nothing more has to be done but to put it into the oven and leave it to bake.

Explain that the baking cooks the loaf through, but that the outside gets more cooked than the inside, and so we get hard brown crust and soft spongy crumb in the same loaf.

IV. DIFFERENT KINDS OF LOAVES

Show the specimen loaves—cottage, brick, tin, cobourg, as the case may be. Explain that the dough, being soft, is easily worked up into any shape we please, and that it keeps this shape while it is baking in the oven. Some people like one shape, some like another.

Lesson III

FLOUR

Articles for illustrating the lesson will be : some specimens of flour—whole meal, fine whites, seconds, households ; some pollard, bran, and grains of wheat ; a hamster ; pictures showing the interior of a mill and the dressing machine ; pictures of a windmill and a water-wheel.

I. WHAT IT IS

INTRODUCE the new lesson by eliciting from the children briefly

and rapidly what they know of the materials used in bread-making, and the object of each, and then show some flour in a saucer.

This flour is the most important of all the materials. We are now going to learn what it is, where it comes from, and a great many other useful things about it.

Let one of the children come to the front, and take some of it in her hand. Lead her to tell that it is a very fine powder, like white dust. Notice how it sticks to her hand.

Let her rub some of it between her fingers—it feels very soft and smooth as she rubs it.

Show some grains of wheat, and tell that this fine white powder was made from little grains like them.

Perhaps some girl can tell me what these little brown things are. They are **grains of wheat**.

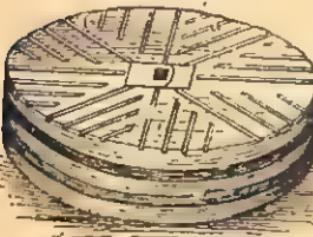
Quite right. They are grains of wheat. See, I will now make some flour from them.

*Crush up some of the grains with a hammer, and call upon the children to notice that, although the **outside** of the grain is **brown**, the **inside** is **white**. It is this white inside part which makes our flour when the grains are broken up.*

*Explain that it would take too long to crush up the grains with a hammer in this way to make all the flour we want. They have to be **ground up in a mill**. The man who does this is called a **miller**.*

II. THE MILL.

In the mill the work of grinding is done by **two great millstones**. These are round and flat, and are placed with their flat sides one above the other, just as I might place these two pennies. When the mill is at work the **upper stone moves round and round** very rapidly.

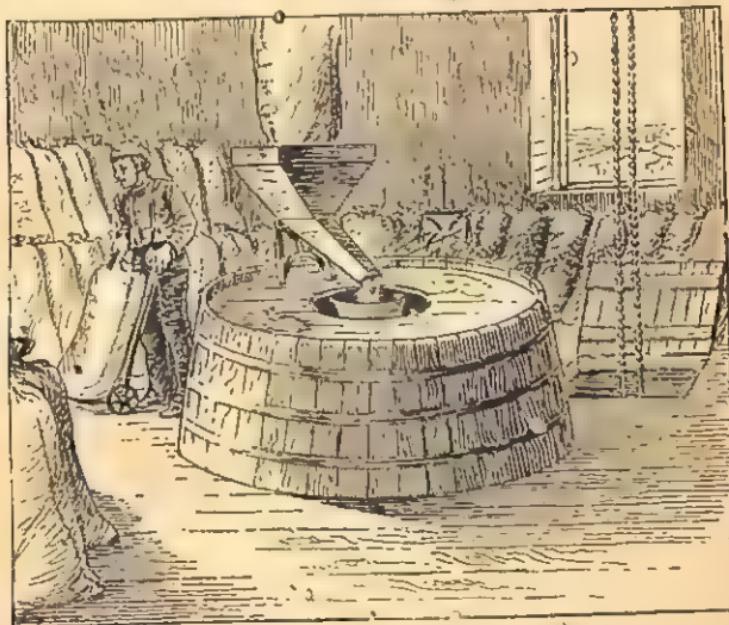


*Make a blackboard sketch of one of the stones, and call attention to the **grooves** cut in its surface. Tell that the*

sharp edges of these grooves cut up and grind the corn to powder, as the top stone moves round on the under one.

The grains of wheat are poured, a few at a time, through a hole in the top stone, as it whirls round, and the whirling movement carries them between the two to be ground up.

Show a picture of the interior of the mill. Call attention to the **hopper**, a sort of funnel-shaped box placed exactly over the hole in the top stone. The wheat is first run into the hopper



from a sack, and from the bottom of this funnel it drops, little by little, between the grinding-stones as it is wanted.

Point out that the stones themselves are **boxed in** with a **wooden casing**, to prevent the flour from being scattered about and wasted. Explain, too, that the draught of air, caused by the rapid whirl of the stone, **blows out the flour** as quickly as it is ground, so that the millstones never get clogged.

Excite the curiosity of the children next by reminding them that this great millstone is very heavy. A man—even a very strong man—would not be able to keep it moving, and yet it has

to spin round very rapidly indeed. Let us see how this is done.

Show a picture of a **windmill**. Explain the use of the great sails. The wind blows against them and drives them round, and as they swing round on the outside they move the



stone itself inside the mill. But it is the wind that does it all. We call this a **windmill**.

Where must a windmill be built to catch the breeze, and why? What happens when there is no wind?

Next show a picture of a **water-mill**. Call attention to the great wheel on the outside of the building. It dips down into the water. Explain that it is made to move round by the force of the running stream. It is **water**, not wind, which works this mill. We call it a **water-mill**.

What must happen to such a mill in the dry summer

when there is very little water in the stream, or in the winter when it is frozen over?

Tell that most mills are now worked by steam. The great steam-engines work on, night and day, without stopping, as long



as they are wanted. These mills are better than either wind-mills or water-mills.

III KINDS OF FLOUR

Show specimens of whole-meal, fine whites, seconds or households, pollard and bran. Explain that all these come from the grains of wheat. Leave the names for the present.

The ground wheat, which falls away from the millstones, is not flour like this in the saucer. It is coarse, brown-looking stuff like that which I showed you first. The miller calls it meal, and because it contains the whole of the grain he also calls it whole-meal. Take some of it in your hand, and see if you can tell me the difference between it and the fine white flour.

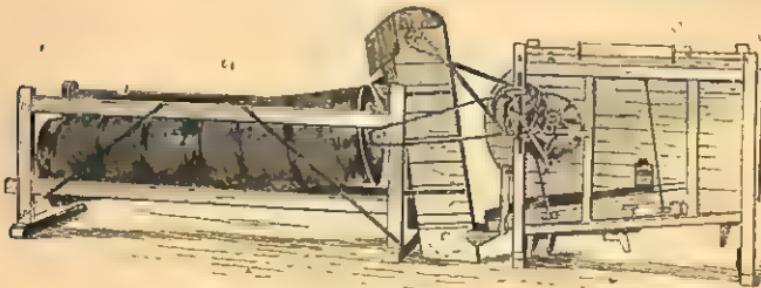
Lead the children in this way to pick out the coarse scaly particles of the meal. They cannot find any of these in the white flour. That is very fine, soft, and smooth. Yet all flour was at first coarse like this meal.

What would be a good way to get the fine flour from this coarse meal? We might sift it.

Well, that is exactly what the miller does. The most important part of his work begins when the millstones have ground up the grain into coarse meal like this. He calls it **dressing the meal**, and this dressing gives him different qualities of flour, such as **finest whites, seconds or households**, and a third or coarser kind still, known as **tailings**. The coarse, brown, scaly particles are separated out from the flour by this sifting, and are called **pollard and bran**. **Bran is the coarsest part of all.**

Show the specimens as they are described, and lastly proceed to examine the pollard and bran.

Lead the children, by their own observation of the specimens, side by side with the grain itself, to the conclusion that these



THE DRESSING MACHINE.

coarse, brown, flat particles of pollard and bran must be pieces of the outside skin of the wheat. Tell the difference between the two.

Describe briefly the dressing machine. It is a sort of long barrel, covered with gauze. The first, or upper part of it, is a very fine gauze made of silk; the rest is made of wire, with coarser and coarser meshes towards the lower part.

A long spindle-brush runs through the middle of the barrel from end to end, and the barrel itself is placed in a slanting position. Both barrel and brush are made to revolve very fast.

When the meal is poured in at the top the revolving brush sweeps it through the meshes of this sieve. Only the finest flour falls through first. Why? This is caught in a large bin placed below, and then the seconds or households follow through the coarser meshes which come next. The tailings fall through a still coarser part lower down; the pollard goes next; and so at the lowest end nothing is left but the bran.

We use the different kinds of flour for different purposes:—

Most of our bread is made of seconds' or households' flour. This makes better bread than the very fine flour.

Whole-meal bread is made of the meal just as it leaves the millstones. It is not sifted; it makes brown bread. This is very good to eat.

The very finest white flour is best for making pastry.

Bran and pollard are used for feeding animals, such as rabbits, pigs, and poultry.

Lesson IV

CORN

The teacher should be provided with some ears of wheat, barley, and oats, and some young corn-plants growing in a flower-pot.

I. AN EAR OF WHEAT

COMMENCE with a few minutes' chat about flour—the useful material which makes our bread, biscuits, cakes, pies, and puddings.

Flour is got by grinding grains of wheat in a mill. We are going to learn something to-day about the grain itself.

Show a few ears of wheat. Without telling what they are, let a girl come to the front, and rub one of them in her hands, and call upon the rest to observe what takes place. They see that, as she rubs the ear, the grains fall on the table.

What are these little things which are dropping out one by one on the table? Take them up and examine them. They are **grains of wheat**, like those which the miller grinds into flour.

Quite right. We call this an **ear of wheat**; all wheat grains come from ears like this.

Now, as we have got all the grains out of the ear, suppose we examine it and see what it is like.

Pick off the empty cases or shells carefully, one by one, and show how they were arranged round the central stalk. Explain that each little shell held a grain of wheat. We call this shell the **husk** or **chaff**.

Let us try to find out what use this husk was to the grain, for you may be sure it had a use of some sort.

These ears of wheat grew on plants in a field. They always grow on the very top of the stem; and while they are growing the weather is sometimes very wet and cold. This cold and wet would kill the young grain in the ears unless they were covered up in some way.

How do we keep ourselves warm and dry in the bad weather? We put on our warm cloaks and topcoats.

Then that will help you to understand what use this husk or shell is to the growing grain of wheat. **The husk is its topcoat** to keep it warm and dry in the cold wet weather.

Have the husks themselves examined next. Lead the children to tell that they are very thin and very light. They



are so light that we can easily blow them away. Still they are quite thick enough to take care of the grain inside. The rain which falls upon them rolls off, instead of soaking through to hurt the tender young grain.

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II. THE GRAIN

Hand the grains of wheat round the class for examination, and lead the children to describe them as far as they can from their own observation.

What shape shall we call these grains?
Oval.

Yes, they are oval, but if you look carefully you will see that **one end is more pointed than the other**. Now what can you tell me about the sides of the grain? One side is **round**, the other is **flat**.

Look at the flat side again, and see if there is anything else to notice about it. There is a long groove running from one end to the other on the flat side; but there is no groove on the round side.

Now look at the large end of the grain. What do you see? There is a small oval spot near that end; but there is no mark of any kind at the other end.



Explain that this larger rounded end is the bottom of the grain. This spot marks the place where the grain was joined to the central stalk at the bottom of the husk. Make an enlarged drawing of one of the grains on the black-board as the description proceeds.

Produce the sprouting grains in the flower-pot. Pull up one or two of the tiny plantlets, and hand them round for examination. Notice that something has been going on at the lower end of each grain.

From this larger rounded end a number of small white threads have spread downwards into the soil; and from the



same spot a little green thing, like a tiny blade of grass, has pushed its way upwards into the air.

Lead the children to talk about the seeds which they sow in the gardens in the spring-time, and what becomes of them, and so arrive at the conclusion that these grains are really **the seeds of the wheat plant.**

Those little white threads stretching down into the soil are



The roots; the green part which forces its way upwards is the stem. The seed would in time become a new plant if we left it to grow.

III. OTHER GRAINS.

So far we have spoken only of grains of wheat, because

we always use wheat to make flour for our bread; But there are many other kinds of grain besides this one.

Show an ear of barley. Let the children compare it side by side with the ear of wheat, and point out the differences between the two. This need only be done in a simple way now, as it will be dealt with, more in detail in a later lesson.

The first point to strike them will be the **beard**, which is formed by **long spikes** coming from the ends of the grain. There was no beard in the ear of wheat.

N.B.—It is assumed that autumn-sown wheat was used in the earlier part of the lesson. Spring wheat, like barley, is bearded. This, however, may safely be left for the present.

Pluck the grains from the ear of barley, and let the children examine them side by side with the grains of wheat. Call attention to the central stalk, when the ears have all been stripped off, and lead the children to point out another difference.

The ears of barley have **no outer shell or husk** to cover them up from the bad weather. Let us see why this is.

If you take one of the grains of wheat, and press it with the sharp edge of your thumb nail, you will be easily able to cut it in two. Let this be done.

Now try to do the same with the grain of barley. You find you cannot do it, because barley is much harder and tougher than wheat. Barley is very hardy, and will stand much more bad cold weather than wheat. It does not want to be covered up with a husk.

Next show the ear of oats. Call attention to the way in which each grain hangs with its open end downwards. This ear is not like either the wheat or the barley.



Tell that oats will grow in much colder, damper countries than either wheat or barley, and lead the class to reason out for themselves the purpose of this special arrangement of the ears.

Each grain of oats, like the grain of wheat, has its own outer **husk** or covering, but in this case, as the open end hangs downwards towards the earth, the rain readily rolls off as it falls, and leaves the grain inside quite dry.

We have one common name for all these—**wheat**, **barley**, and **oats**. We call them all **corn**; and we speak of the field in which they grow as a **corn-field**.

Lesson V

THE CORN-PLANT

Place on the table the flower-pot, with growing corn-plants as used in the preceding lesson; also provide a bundle of long straws, a tuft of tall grass, a few common leaves, a picture of the growing corn-plant, a pocket-knife.

I. INTRODUCTION

THE growing wheat in the flower-pot will, under favourable conditions, have made some headway since the last lesson. It should be produced now, and made to serve a useful purpose in recapitulation.

What are these little green things growing in the pot? They are young **corn-plants**.

How do plants spring up in the soil? They **grow from seeds**.

What kind of seeds did I put into the flower-pot to make these little corn-plants grow? **Grains of wheat**.

Quite right. These grains are the seeds of the big, full-grown corn-plant; they grow packed close together in the ear.

II. CORN IS GRASS

I want you now to examine these tiny plants for yourselves, and tell me all you can about them, before we go any further.

What do they look like? **They look like grass.**

Pull them up carefully and hand them round the class for inspection. Point out the grain of wheat from which the little plant grew, and lead the children to trace the green blade upwards and the root fibres downwards. Both spring from the same oval spot at the larger end of the grain.

If you could see a corn-field, with the young plants coming up, it would look just like a field of grass; and I want you to remember not only that these corn-plants look like grass, but that **they really are a kind of grass.**

The grass on our lawns is kept short and smooth by constant cutting, but the grass in the fields and meadows is sometimes allowed to grow high.

• What do we do with it? In the summer-time men cut the tall grass down, and dry it in the sun to make hay.

This corn-grass, too, grows very tall—taller than most of you girls.

III. STALKS AND LEAVES

Show a bundle of long straws. Let the children examine them, and tell what they are. Mention a few of the uses we make of straw.

You are quite right in calling them straw; but look at them once more, and see if you can tell me what they really are. I will tell you. They are simply **the long stalks of the corn-plants** that once grew in the fields.

Our little corn-plants in the flower-pot are green, like all other grass, and so are the plants in the corn-field at first. But when they get ripe they turn yellow, just like this straw.

Let the children proceed with their examination of the straws. Point out the knots or joints in them. Explain that when

the straws were green corn-stalks growing in the field, the leaves sprang from these knots or joints.



Produce the tuft of tall grass now. Let the children examine it, and find for themselves the rounded stalk, with its **knots** or **joints** at regular intervals, and the long, narrow, **pointed leaves** springing out from them. If they compare these round jointed stalks with the straws, they will easily see the connection between the two.

Split up the stalk of the grass next with a knife, and show that it is really a **hollow tube**, divided into short lengths at the joints.

Explain that although hollow it is **very tough and strong**, and will not easily break. The knots or joints help very much to strengthen this **hollow stalk**.

Proceed to deal in exactly the same way with the straws, and show that they, too, are **round, hollow, and jointed**, just like the common grass stalks.

Have the leaves of the grass examined next. Tell that we call them **blades of grass**.

Hold them up to the light, and call upon the children to tell what they see.

They will notice a great many fine lines running close together, side by side, from one end of the blade to the other.

Explain that these are the **veins of the leaves**, and

because they lie side by side in this way we say they are parallel.

Show a few common leaves of various sorts, and have them examined in the same way. Point out that these leaves have veins too, but they do not run side by side from one end of the leaf to the other. They spread all through the leaf in every direction.

The leaves of the corn-plants, like these of all grasses, have their veins running in straight lines side by side.

A picture of the growing corn-plant should now be shown, and the children will readily see that this is in every respect like the grass they have just examined.

There are the same round, jointed stalks and the same long, narrow pointed leaves at each joint. We speak of the corn-plants as corn-grasses.

IV. THE EAR

Each corn-plant sends up five or six separate stalks. The ear is, in each case, the topmost extremity of the stalk.

Call attention to the admirable arrangement of those long leaves, which are meant as a protection for the tender young ear.

As the stem rises, the last leaf always enfolds it closely in a sort of sheath to protect it from the weather, until the tender ear is able to brave the sun, and wind, and rain without protection. Then it unfolds at the top, and the ear is left to grow big, and ripen with the warm sunshine.

But even when the leaf unfolds, the little grains in the



ear are not left altogether exposed to the weather. How is each little grain in the ear protected? It is covered up in its **husk or shell**.

Explain that the young ears are at first green like the rest of the plant. As they ripen they turn to a golden brown colour, like those ears we examined in our last lesson.

When the corn is fully ripe men cut it down and carry it away. The ears are then full of grain, which is sent to the miller to be ground into flour.

Lesson VI

THE CORN-FIELD (HARVEST)

Teacher will require pictures of the harvest-field, a sickle, a scythe, a flail, a reaping machine, and a threshing machine.

I. INTRODUCTION

INTRODUCE the new lesson by referring once more to the loaf of bread, and lead the children to tell its history, step by step, in some such way as this:—

What is the most important material used in making bread? Flour.

What is flour? Flour is a white powder made by grinding wheat in a mill.

What is wheat? Wheat is the seed or grain of the wheat plant.

What can you tell me about this plant? It is a sort of grass.

Do you know any other grains which grow on plants like this? Oats and barley grow on grasses too.

What name do we give to all three? We call them corn.

Which of them is the best? Wheat is the best of all; that is why we use it to make our bread.

On which part of the plant do the grains grow? They grow in the ears at the top of the stalks.

Where do these corn-plants grow? They grow **in the corn-fields in the country**.

II. HARVEST-TIME

Show a picture of the harvest-field.

Here we have a pretty picture which reminds us of the country. It is a picture of a corn-field. We can see it is bright, warm weather, for the men are at work in their shirt-sleeves.

We will find out what they are doing presently. I



want you first to have a good look at the corn in the picture. You told me just now that corn is a sort of grass, and of course all grass is green. This corn is yellow, not green. What does it mean? When the corn is ripe, **the ears and stalks turn yellow.** This corn is ripe.

Quite right. We often speak of **the golden corn**, because it turns to a rich golden yellow when it is ripe. The farmer then knows it is time for him to gather it. Let us see how he does this.

1. Reaping.—I think I told you in our last lesson

that the ripe corn has to be cut down. This is called **reaping the corn**, and the men who **reap** it are called **reapers**.

Show a picture of the **sickle** or **reaping hook**, or a model of the implement itself, if possible. Call attention to the **narrow, curved blade**, with its edge of fine, saw-like **teeth**, and the **short, rounded handle**, just big enough to hold it by, without being in the way.

This is the curious knife which the reaper uses to cut down the corn.



We will next see how he uses it. With his left hand and arm he grasps as much of the ripe standing corn as he can hold. This he bends backward, and then, with the sickle in his right hand, he makes a sweeping cut through the stalks of the whole bundle, a few inches above the ground.

This finishes his part of the work, for he hands over the bundle he has cut to another worker, generally a woman or a girl, and she ties it up in a **sheaf**.

As the sheaves are cut and tied one by one, they are piled up on end together. A number of **sheaves** piled up in this way make a **shock of corn**; and the shocks are left standing there in the field for some days to dry.

Explain that this is the old-fashioned way of reaping. It did very well for small fields, but where the farmer has a very large quantity of corn to cut he has to find a quicker way of doing it.

Remind the children that at this time of the year, when the corn reaping is going on, we frequently get violent storms of rain. The rain would spoil the corn; that is why the farmer likes to get it cut quickly.

Show a picture of the scythe. Explain that this implement is used for mowing the grass to make hay, but sometimes the farmer uses it to cut down the corn, because it will do the work quicker than the sickle. Point out the long, curved steel blade at the end of the long handle. Tell that this blade is very sharp, and as it sweeps round, it cuts down a great heap of grass or corn every time.

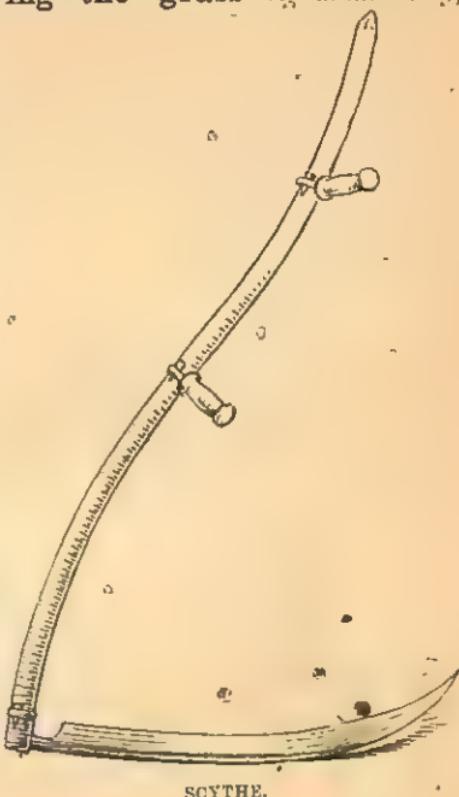
Mowing with the scythe is not so good as hand-reaping with the sickle, because the corn is strewn about the ground, instead of being tied up at once, and the grain is very likely to fall out of the loose ears, and be lost.

On all large farms the corn is now cut by clever reaping machines.

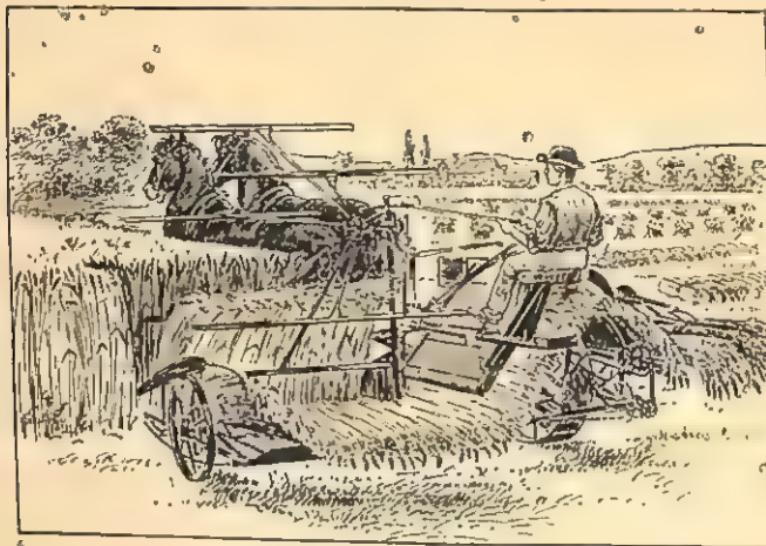
Show a picture of one of them.

These machines not only cut the corn down, but bind it into sheaves as well, and throw the sheaves out in rows, as they pass along; and they do all this much more quickly, and much better than the men can do it. The men have nothing to do but stack the sheaves in shocks, and leave them to dry.

2. Carting.—Call attention once more to the picture of the harvest-field. Point out the great waggon's laden with corn. Explain that these are the sheaves, which, after standing in the field long enough to dry, are now being carted away to the farm-yard.



SCYTHE.



III. THRESHING THE CORN

When I gave you the ear of corn to examine, how did you get the grain out of the ear? We rubbed the ear in our hands and **the grains fell out.**

What was left behind? Only the loose empty **husks or chaff.**

What do you remember about this chaff? It is **very light**—so light that we can **easily blow it away.**

This will lead the way to the next work of threshing and winnowing.

Show a picture of the old, hand flail, with its loose flap,



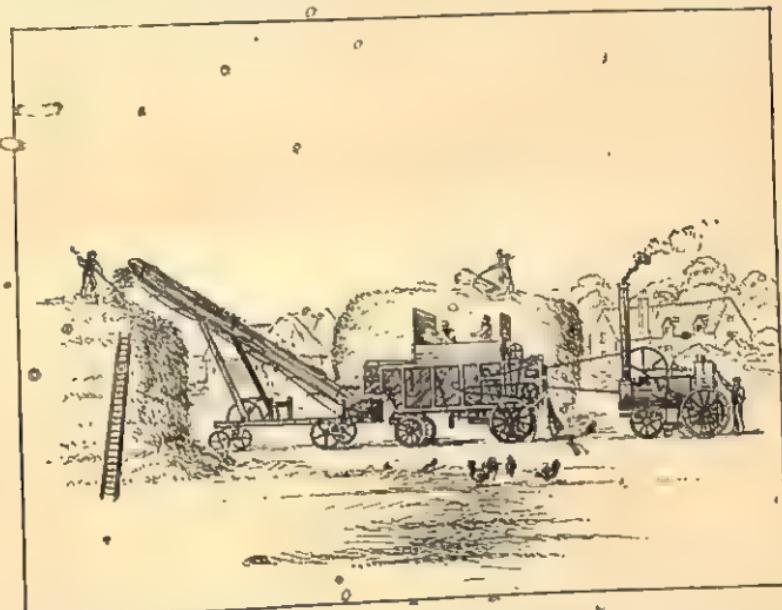
HAND-FLAIL.

joined to the long handle by a strip of leather. Explain that

the thresher shook the grains from the husk or chaff by beating it with this flail. This part of the work was always done on the floor of a great shed known as the barn. We call it threshing the corn.

It was very hard work, and when it was done, the corn had to be winnowed to separate the grain from the light husk or chaff.

The old way of winnowing was to pile up the threshed corn in a heap at one end of the barn, and then throw it,



a shovelful at a time, to the other end. The heavy grain, of course, would fall to the floor, but the light, chaff would blow about and settle by itself.

These simple old methods would never do now on our large farms. The threshing and winnowing are nearly always done now by a great threshing machine, and in the field itself where the corn has been growing.

Show a picture of one of these machines at work.

They do the work much faster, and also save the trouble of carting the corn. As the grain is cleared from the husk it passes out at one end of the machine, and is

caught in sacks placed there to receive it, while the straw is bound up at once into trusses or bundles, and stacked in a rick. The whole of the work is done by this clever machine.

Lesson VII.

THE CORN-FIELD (SEED-TIME)

Provide for illustration the following pictures: ploughing, harrowing, sowing with a drill, rolling.

I. INTRODUCTION

IN our last lesson we had a look at the corn-field, as it is in the summer-time, when the corn is ripe, and the reapers are at work gathering in the harvest.

We are now going to find out how the farmer makes the corn grow in his fields; but before we begin that, I shall want you to tell me all you can remember about the kind of work that is going on in the fields at harvest-time.

A few carefully chosen questions will elicit from the children all the essential points in connection with the work of harvesting and threshing the corn. This should be done in a simple way, without insisting upon too much detail, and the children should be encouraged to describe in their own words the operations and the implements used.

II. PLOUGHING

Some of you may have gardens at home. I want you to think about them, and tell me what is the first thing to be done, if we want to grow some plants in our gardens. We must begin by digging the ground.

What do we use to dig up the ground? We use a spade.

Lead them to tell from their own observation that digging is hard work, and takes a long time, and then picture to them one of the farmer's immense fields. It would take a great number of men several weeks to dig this one field all over, and

the farmer most likely has many such fields. Digging with the spade would never do for him.

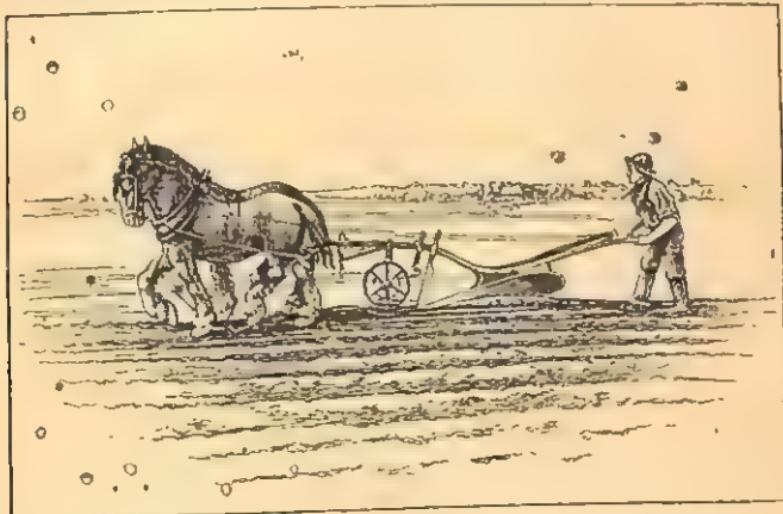
Show a picture or a model of a plough—a simple form of the implement will be best for the purpose. Tell its name and explain that this is what the farmer uses to turn up the ground:

Call attention to the share. Tell that this is made of steel, and is always kept clean and bright. It has a sharp cutting point and edges. It is this part of the plough which does the work of cutting through the soil, and turning it up.



Notice next the body of the plough, with its wheels in front and a pair of long handles behind.

With this useful implement a ploughman can turn over very much more ground in one day than he could dig



with a spade in a whole month. This is why the farmer ploughs his fields with a plough, instead of having them dug with a spade. Let us next see how the work is done.

Show a picture of the ploughman at work.

The first thing, probably, to strike the children will be the horses in front, for, till now, no mention has been made of

horses. Explain that the horses draw the plough, and the man walks behind. He holds the reins in one hand to guide the horses, and he presses down upon the long handles to drive the point of the plough-share well into the soil. As it moves across the field, the share cuts through the soil, and turns it over in a straight ridge.

Explain that, when the farmer has a very large extent of land to plough, he finds that even powerful horses like these

cannot do the work quickly enough. He then uses a steam-engine instead of horses to draw the plough. A steam-engine can do as much work as many horses, and so he is able to plough very much more land in the same time.

Now which do you think is best for turning up the soil, a plough or a spade? A plough.

You all say a plough is best; then why not use a plough, instead of a spade, for digging up our gardens? A plough is best for great fields, but it would not do for our gardens. A spade is better than a plough for that work.

Now, last of all, let us see why it is so important to have the soil turned up if we want anything to grow in it. You will at once say that the digging or ploughing breaks up the soil and makes it soft. So it does, and the soil must be soft, or the young roots of the plants will not be able to make their way down into it.

But besides this it is important to bring the under soil to the surface, so that the sun, and air, and rain may act upon it—otherwise nothing would grow in it.

GARDEN-RAKE.



III. HARROWING

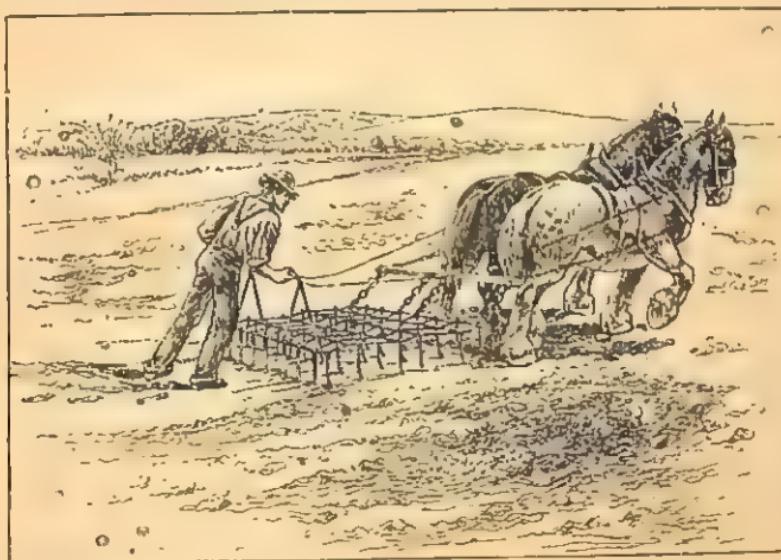
What do we do in our gardens when we have dug the ground all over with the spade? We make it smooth, and break up all the stiff, hard lumps with the **rake**.

Explain that this has to be done to make a nice smooth bed for the seeds.

Show a picture of the garden rake, or, better still, an actual rake, and lead the children to tell that this would never do the work in a great field.

This is the kind of rake the farmer uses on his fields. He calls it a **harrow**.

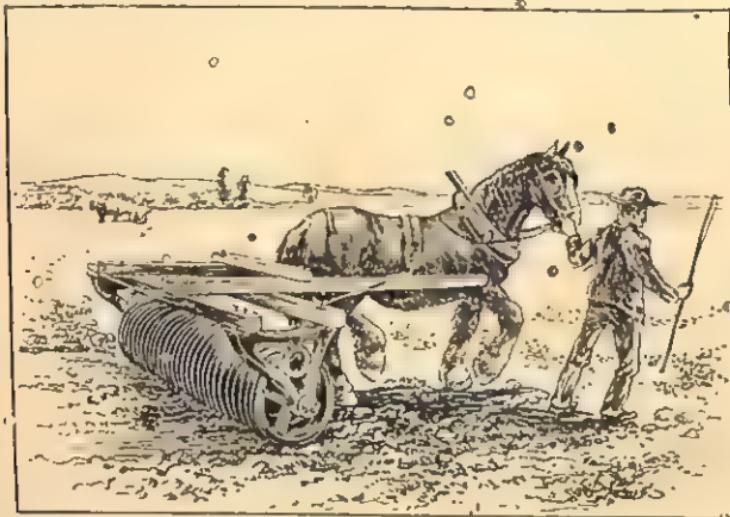
Show a picture of the implement, and tell that, in this case



again, horses draw it over the field. The long sharp spikes or teeth break up the lumps, and leave the surface of the soil smooth.

Explain that on some heavy kinds of soil the harrow is not able to break up the clods or lumps. Another implement called a clod-crusher is used for this purpose.

Show a picture of this implement, and tell how it is used. The great heavy roller with its rows of iron teeth easily breaks up the hardest clods of earth.



IV. SOWING THE SEED

After the harrow has done its work the soil is fit to receive the seed. How do we sow the seeds in the garden? We scatter them on the ground with our hands.

Lead the children to tell that this would be a very slow, tedious way of sowing the corn in a great field, although formerly it was always done in this way. Men carried a basket of corn slung round their necks, and scattered it over the field, a handful at a time, as they walked along.

We do it in a quicker and better way now. The corn is put into a great box on wheels, and this is drawn across the field by a horse. As it moves along the seeds fall, a few at a time, through a number of holes at equal distances apart in the bottom of the box. This box is called a drill, and it sows the seeds much more quickly, and of course much better, than a man could scatter them with his hands.

When the little plants spring up, they are seen in **long, straight, even lines**, stretching from one side of the field to the other.

After the seed is sown, a **roller** is drawn across the field to press the soil close to the grain, and when the



little plants begin to show, the field is again rolled to **press the roots firmly into the soil**.

The farmer sows his corn either in the autumn or the spring, and from the time the little green blades peep through the soil, till the ears are ripe, he has plenty of work to do in **keeping down the weeds**, which would soon choke and kill the corn if they were allowed to grow.

Lesson VIII

MILK

Have ready on the table a glass of new milk, a jug of water, three or four tumblers, a glass marble, a piece of cork ; and provide also a picture of milking-time.

I. PROPERTIES

Hold up a glass of milk before the class.

You all know what this is. You see milk on the table at meal-times every day of your lives. We are going to learn something about milk now.

First of all look at it yourselves, and try to tell me something about it. What colour is it ? It is white.

Let us compare it with this glass of water. Look, I will hold this penny behind the water. Can you see the penny ? Yes.

Now I will hold it behind the glass of milk. Can you see it this time ? No, we can see the penny through the water, but we cannot see it through the milk.

In this way lead up to the words transparent and opaque, and let the children give other examples.

Milk, then, is opaque ; water is transparent.

But you told me just now that milk is white. Is water white too ? No, water is not the same colour as milk.

What colour is it then ?

This will probably puzzle the children at first ; but a few samples of coloured water will soon set their minds at rest. A drop or two of red, black, and blue ink in a glass of water will explain all. Water has no colour.

Now suppose we notice next some point in which the water and the milk are alike.

Pour the water from one glass into another, and then do the same with the milk. Pour some of each on a slate, and show

that, when the slate is tilted, they both flow about, and would run off and fall to the floor.

Let the children tell that tea and coffee, vinegar, oil and ink would all flow about in the same way.

We have one name for all things that flow about like this. We call them **liquids**. So then water and milk, as well as tea and coffee, vinegar, oil and ink, are all liquids, and we may say that **milk is a white, opaque liquid**.

Next let one of the children close her eyes and taste the water and the milk. Let her tell the class how she knew one from the other.

The **milk is sweet and pleasant to the taste**, but water has no taste at all.

Let her again close her eyes, and show that she can tell the milk from the water quite as easily by smelling them.

The **milk has a sweet, pleasant smell**, but water has no smell.

Take two sheets of clean white paper. Pour a little milk on one, and some clean water on the other. Dry them both before the fire, and then let the children examine them.

The milk leaves a greasy stain on the paper; but there is no stain from the water. Milk then is a **fatty or greasy liquid**. Let us see what we can learn about this fatty part of the milk.

If our eyes were sharp enough to see we should find that the milk is full of **tiny balls of oil or fat**. We cannot see these little balls of fat floating about in the milk, but I have something else to show you which will explain it all.

Show the glass of new milk. Call attention to the **thick yellow cream** on the surface. Let the children tell what it is. Explain that this cream consists of those tiny balls of fat which have risen to the top of the milk. They always rise to the surface if the milk is allowed to stand still.

Why do they rise to the top like this?

Put a small marble and a piece of cork the same size into a tumbler of water. Show that the marble sinks to the bottom; the cork floats on the top.

Why is this? The marble sinks because it is heavy, but the cork is light, and floats on the top.

Now tell me why those little balls of fat rise to the top of the milk, and form cream. They rise because they are lighter than the milk.

II. USES

Lead the children to tell that in London and other great towns all the milk we get is used in its simple form.

We drink it; we put it in our tea, coffee, and cocoa; and we use it for making bread and milk, custards, and puddings.

When you were little babies what kind of food did you have? Milk. Think of baby at home; it grows and gets stronger day by day, and yet it takes nothing but milk.

Milk, then, must be a very satisfying, wholesome, and nourishing food. It is the best of all food to give to sick people, young or old, because it is so easily digested.

Butter and cheese are made from milk. Our next lesson will tell us something about these two things.

III. WHAT IT IS

Now last of all we must learn what this useful liquid food is, and where it comes from.

Lead the children to tell that milk comes from the cow.

Explain that the cow supplies milk to feed her little one, which is called a calf. The little thing is at first unable to eat grass for, like little young babies, it has no teeth. When it gets older and stronger it eats grass as its mother does. It does not want its mother's milk then.

The farmer keeps cows for the sake of the milk they give. A good cow will give from eight to twelve quarts of milk, day by day.

The cows are milked two or three times every day

—always in the morning and evening, and usually again at noon. If they are not milked regularly they suffer great pain.

Show a picture of the farm-yard at milking time. Explain the process, and notice how quietly the cows stand while the



milkmaid squeezes the rich warm milk into the pail. It eases them and makes them feel more comfortable.

Lesson IX

BUTTER

Articles for illustration: a tumbler of cream, a soda-water bottle, a piece of muslin, one or two tumblers, a picture of the dairy.

L INTRODUCTION

WARM a common soda-water bottle, and half fill it with fresh cream, which has been slightly warmed for the purpose. Cork

the bottle up securely, and without entering into any explanation at present, hand it to one of the bigger girls, and instruct her, how to shake it so as to keep it constantly on the move.

While Mary is shaking the bottle we will talk about our last lesson. You remember I poured some milk on a sheet of paper, and dried it before the fire. What did you notice when I showed you the paper afterwards ? There was a **greasy stain on the paper.**

What did that tell us ? It told us that the milk must be a **greasy liquid.**

Why is it greasy ? It is full of **tiny balls of fat or oil.**

What becomes of these balls of fat if the milk is allowed to stand ? **They rise to the surface** because they are lighter than the rest of the milk.

What becomes of them there ? They float on the top of the milk, and form **cream.**

Show the rest of the cream in a tumbler. Notice that it is much thicker than milk, and that, instead of being white like milk, it is **slightly yellow in colour.**

Explain that this cream was skinned off the top of some milk with a large flat spoon.

I had more than this at first, but I put some of it into that bottle. It is cream that Mary has been shaking up all this time. Suppose we have a look at it now.

Stretch a piece of muslin over a tumbler, to form a sort of strainer, and pour out the contents of the bottle on it. Call attention to the liquid which drains through the muslin into the tumbler.

Is it cream ? No, it is too thin for cream.

Is it milk ? No, it is not white enough for milk.

Stand the tumbler aside for the present, and draw attention to the bottle. Point out the **lump of solid yellow stuff in it.**

What is this yellow stuff ? It is **butter.** Mary has made it by shaking up the cream in the bottle. So you see **cream comes from milk, and butter is made from cream.**

II. CHURNING THE BUTTER

Show a picture of a dairy. Describe the place. A large, cool, airy room, always kept spotlessly clean. Point out the wide stone shelves all round the walls, and the large flat earthenware pans on them filled with milk.

Tell that milk would soon turn sour, and go bad, in a close warm place, or if it were kept in vessels that were not quite clean. This explains why the dairy must always be the coolest, the most spotlessly clean, and the most airy room in the farm-house.

Notice the dairy-maid too. She looks as clean and wholesome as the dairy itself.

Why is all this milk standing in the pans? Think of the tumbler of new milk I showed you the other day, and you will be able to tell me. It is left to stand there so that all the cream may rise to the surface.

Refer to the milking-time at the farm. Tell that, as pail after pail is filled with the rich warm milk, it is carried away to the dairy, and poured into these great pans.

Picture the dairy-maid as she passes round from pan to pan, and skims off the cream from the top of the milk with her skimmer. Explain that the milk from which all the cream has been skimmed is called skim-milk.

Call attention to the churn in the picture; describe it briefly, and tell how it is worked.

The cream, after being slightly warmed, is poured into the



barrel of the churn, and then the dairy-maid sets to work with her churning.

You remember that, when Mary shook the cream up in the bottle, she changed it into two new things altogether. What did you see when we emptied the bottle? A **lump of butter** and some sort of liquid.

That is just what the dairy-maid finds when she works the churn.

Remind the children that the cream really consists of a mass of those little balls of fatty oil. Explain that the outside skin of these little balls is very, very thin. When they are shaken about the thin skin bursts, and so the oil, or fat, is set free, and forms into lumps of solid butter.

Tell that this is just what takes place in the churn. When the churning is over the dairy-maid empties out the thin, watery liquid, and the solid butter is seen all round the inside of the churn.

Let us now examine the liquid which we poured out of the bottle into the tumbler. We have seen that it does not look like milk.

Taste it, and then taste some of this milk. Does it taste like milk? No, it **does not taste like milk**.

Think once more, and tell me what this liquid really is. It is the **cream with all the butter taken out of it**.

Quite right. The dairy-maid calls it **butter-milk**. The cream, you see, comes from the milk, and when all the butter has been separated out of the cream by churning, the liquid which remains is called **butter-milk**. Taste it again. It is very pleasant tasting; it makes a cool, refreshing drink for the people about the farm.

III. AFTER THE CHURNING

When the butter is formed it is taken out of the churn and put on a **cold stone table in the dairy**, but it is not yet ready for use.

Explain that, although the butter can be taken out in solid

lumps, it contains a great deal of the butter-milk. The dairy-maid has to get rid of all this watery liquid.

She rolls, and presses, and squeezes it on the cold slab with her hands till all the butter-milk is squeezed out of it.

Show a picture of the maids at work with the butter pats in hand, and remind the children that they have often seen the buttermen in the shop work up the butter into shape in the same way.

Explain that the butter as it comes from the churn would



not keep. The dairy-maid has to mix up a little salt with it while she kneads it on the slab. The salt keeps it from going bad.

When the butter is meant to be used at once only a little salt is added to it; it is called **fresh butter**, and is always sold in rolls or pats. It would not keep very long.

More salt is used for butter that has to be kept for a long time. This is called **salt butter**, and it is always put into **wooden tabs** and closed up till it is wanted for use.

Lesson X

CHEESE

The following articles should be provided: some new and skim milk, vinegar, rennet, two or three tumblers; picture of the cheese press.

I. INTRODUCTION

INTRODUCE the new lesson with a chat about the nature of milk, so far as it has been dealt with already. Proceed in some such way as this:—

Here is a glass of milk. What would happen if we allowed it to stand all day? The cream would rise to the top.

But where is the cream? I cannot see it in the milk. It is floating about in the milk in tiny round balls of fat. **We cannot see it till it comes to the top.**

How can the cream be got from the milk? It has to be skimmed off the top.

What do we call the milk which is left behind, with all the cream taken out of it? We call it **skim-milk**.

What is done with the cream which is skimmed off? It is made into butter.

Quite right. Now, the one thing I want you to remember is that **the cream is in the milk**, although we cannot see it at first. I am next going to show you something else in the milk, which at present you cannot see.

Take the glass of new milk, and, without entering into any explanation, pour a few drops of vinegar into it, calling upon the class to notice carefully what takes place.

Lead them to tell that the milk at once begins to separate into two very different sorts of things. One part of it forms into thick, white, solid lumps; the rest is a liquid, much clearer than milk.

Remind them that the part which has formed those solid lumps, as well as the liquid, in which they are floating, were

in the milk at first. We did not see the white lumps floating about till some of this other liquid in the bottle was poured into the milk.

This liquid, whatever it is, has **curdled the milk**. We call those white, solid lumps **the curd**, and the clear liquid is known as **whey**. When milk is curdled it separates into **curds and whey**.

Now let us examine this liquid in the bottle, and find out what it is. You cannot tell by looking at it, so suppose you pull out the cork and smell it.

Have you found out what it is? It smells like **vinegar**.

Taste it, and then I think you will be able to make sure. What do you now say it is? It is vinegar.

Why did you make such a wry face? It is **very sour**.

You are quite right. It is vinegar, and vinegar, as you know, is a very sour liquid.

So, then, it is this sour vinegar that has curdled the milk. But where did those solid curds come from? Did they come from the tiny balls of fat which make the cream? Let us see.

Produce the tumbler of skim-milk. Tell what it is, and let the children say why it is so called. **All the cream has been taken out of it.**

As before, pour a few drops of vinegar into the glass, and show that exactly the same thing happens. This **skim-milk**, too, at once begins to separate into **curds and whey**, just as the new milk did.

Now, what does this prove? It proves that the curds **do not come from the cream**, because there is no cream at all in skim-milk.

Of course it does. So now we are sure of two things. We know that milk contains cream, although it cannot be seen till it rises to the surface; and that it also contains something else, which we cannot see till it is curdled.

The cream, you know, is made into butter. What do you think we get from the curd of the milk? I will tell you; the curd is made into cheese.

II. HOW CHEESE IS MADE

We have seen the sour vinegar curdle the milk in the tumbler, and whenever milk is to be made into cheese it has to be first separated, by some means or other, into the two things—**curds and whey**. But vinegar would not be the best thing to use to make the curds for cheese.

1. **Rennet**.—You all know what the young cow is called? A calf.

Quite right. Perhaps, too, you know that some of the young calves are killed, and that their flesh is the meat which we call **veal**.

When a calf is killed the men always save its **stomach**—the bag inside, which holds the food. If you could see this when it is first taken out of the animal and cut open, it would look something like a **piece of tripe**.

It is salted, and hung up in a warm place to dry, and there it hangs, perhaps for a year, till it looks more like a **piece of thick, dry skin** than anything else. It is then fit for use; but let us see how it is used.

It has simply to be soaked in boiling water, and when it is cool the liquor is strained off and bottled. **The liquor is called rennet**. It has a **sour taste**, and will curdle milk much better than our vinegar can do it. This rennet is always used in making cheese.

2. **Forming the curd**.—Picture the cheese-house in one of our cheese-farms—a large, cool outhouse, with a stone floor, and a number of great tubs ranged round the walls. One of these tubs is often big enough to hold a **hundred gallons of milk**.

Be sure that the children are led to form a fair idea of what this means. Show a quart mug; tell that it would take four of these mugs to fill a gallon-measure.

The milk, after being warmed, is poured into one of these tubs, and then the rennet is added. **Half-a-pint of rennet** is enough to turn a **hundred gallons of milk** into curds and whey.

It is allowed to stand for about an hour, and is then

strained through canvas to separate the curds from the whey.

Turn to the curdled milk in the tumbler now, and show how this may be done by straining it through a cloth.

3. Making the curd into cheese.—Let the children examine the pieces of curd for themselves, and show that although they are solid, they contain a great deal of the whey.

Explain that the first thing in the work of cheese-making is to get rid of all this watery whey. The curd is first cut up into small pieces, and then put into a vessel called a cheese vat, where it is pressed and left to drain.

After this it is again cut up into small pieces and salted, and then put into a mould the same shape as the cheese is to be. This mould is placed in a cheese-press, where it is kept till it is dry and hard.

When the cheeses are taken out of the press they are stood on shelves all round a great room, and left there for months to dry.

Tell the children that some day they shall learn more about this part of the work of cheese-making.

Lesson XI

SALT

Provide for illustration a lump of table salt, some loaf sugar, tartaric acid, sulphate of quinine, powdered chalk, brick dust, sand, rock-salt, four small saucers, three or four tumblers, and a jug of water.

I. INTRODUCTION

Show the lump of table salt, and call upon the class to tell what it is. Remind them that they see salt on the table at every meal. It must be a very important article of food.

Lead them to tell, by referring them to their earlier lessons, that salt is always mixed with the flour to make bread, cakes,

and puddings; and that butter and cheese must also be salted when they are made. These things would not be good without salt. Let us learn something about this useful article now.

II. PROPERTIES

Look at the lump of salt on the table. What can you tell me about it by simply looking at it? It is **white**; it is a **solid**.

Look at this piece of coal by the side of it. What do your eyes tell you about that? The coal is a black, solid body.

Now I will place the piece of coal behind the lump of salt. Can you see the coal? No.

What else have you then to tell me about the salt? It is **opaque**.

Yes, our eyes tell us that the salt is a **white, opaque, solid body**. Now let us see what more we can learn.

Let one of the children come to the front, and take the salt in her hand. Lead her to tell that it feels **rough and hard** to the touch, and then show how easily a piece of it may be broken off with the fingers.

What must we say about the salt because it breaks easily? We must say that it is **brittle**.

Rub two pieces of salt together, and call attention to the heap of **powdered grains** which fall from them as they are rubbed.

Salt easily **crumbles up** into small grains. We say it is **friable**.

Remind the children that this is a very useful property of salt. We always use powdered salt at our meals, but if salt were hard like a stone it would not be easy to grind it up.

We have learnt all we can by using our eyes and our hands; but we could still learn something about salt without either looking at it or touching it.

Take four small saucers. Into one of them grate a little lump sugar, into another a similar quantity of salt, into the third put some tartaric acid, and into the fourth a little sulphate of quinine.

Here we have four white powders. They all look very much alike. How could we find out which is the salt? We could tell by tasting them.

Call one of the girls to the front, and let her put the tip of her tongue to each of the powders in succession.

Have you found out anything? This one tastes sweet.

Is that the salt then? No.

How do you know it is not? This is sweet like sugar; salt has not a sweet taste.

Try the next one. What do you say about that? That tastes sour like vinegar.

Is that the salt? No; salt has not a sour taste.

Quite right; now taste the next powder. Is this the salt? No; this tastes very bitter, and salt is not bitter.

Have the salt tasted next, and lead the child to tell that this does not taste like any of the other things—it is neither sweet, sour, nor bitter. It has a flavour of its own. We say it tastes salt.

Lastly, put a spoonful of salt into a tumbler of water, and stir it for a while, till all the salt has disappeared. Now hand the glass round.

What has become of the salt? You saw me put it into the water, but it is all gone; we cannot see it now. Is the salt really in the water? Let us prove that it is.

Dip the tip of your finger in the water, and put it to your tongue. What do you notice? The water tastes salt.

Quite right; and of course it is the salt that has given it this taste. The salt is still in the water although we cannot see it.

Explain that the water has broken up the salt into very tiny pieces—so small indeed that we cannot see them. We say the salt is dissolved.

Put into another tumbler of water some powdered chalk, brick-dust, or fine sand. Stir up as before, and then show that these things do not break up and disappear in the water. They

do not dissolve in the water as salt does ; they sink to the bottom and settle there in a heap.

III. WHAT SALT IS

Produce the piece of rock salt. Without saying what it is, let the children handle it, and examine it for themselves. It looks like a lump of smooth, shiny, reddish-brown **stone**, and it is almost as hard as stone.

When they have been led, step by step, to tell all this, proceed as follows :—

But you have not yet finished examining it. Your eyes and your hands cannot tell you everything. How could you find out something more about this dirty brown stone ? No answer. (*The children would scarcely think of tasting a piece of stone.*)

Well, put your tongue to it, and I think you will learn something more about it. What have you found out now ? **It tastes just like salt.**

Yes, it tastes like salt because it really is salt. Our lump of white salt was once a dirty brown colour just like this. Look at it again ; it looks more like a lump of stone or rock than anything else. We call it **rock salt**.

Rock salt is found in the earth, like stone, slate, chalk, and other things of that sort ; but, like them, it does not grow in the earth—it is, not a plant. **It is a mineral.**

This rock salt is mostly found in great **beds or layers**, which stretch for miles under ground. But in some places it is found lying on the surface of the ground.

Lead the children to tell what they can of coal and other minerals, that are similarly found in beds deep down under the earth.

How do men get these minerals out of the earth for our use ? They make great deep holes, or **mines**, in the earth, and **dig out the minerals**.

Quite right. This **rock salt**, too, is dug out of **great deep mines**. Some day you shall learn how this white,

sparkling, crumbling salt is got from hard, brown, shiny rock salt.

IV. USES

Think for a moment about our lessons on bread. Why does the baker put salt with the flour for his bread? **It makes the bread taste nice.** We should not like the taste of bread without salt.

Why does the dairy-maid put salt with her butter and cheese? The salt keeps the butter and cheese good for a long time. **Without salt they would soon go bad.**

Quite right. We put salt with all our food to give it a better taste. Our food would be very insipid without salt. This is why we always have salt on the table at meal-times.

When food has to be kept for a long time more salt is put with it, and **the salt keeps it from going bad.**

We use salt, you see, with our food because we like the taste of it; but there is a better reason for using it than that. **We could not do without salt;** we should soon become very ill if we could get none.

All animals, as well as ourselves, **want salt to keep them well.** Even the wild animals of the forest seem to know that they must have salt, for they often wander many many miles to find it for themselves.

People who keep horses always place a lump of rock salt in the manger with the food, and the animals lick off just as much as they want from time to time.

Lesson XII

SUGAR

Have ready for illustration specimens of coarse brown and loaf sugar, a lump of table salt, some treacle, a few fresh green leaves, a jug of warm water, a hammer, two or three tumblers, and pictures of the sugar-cane, sugar-harvest, and sugar-mill.

I. INTRODUCTION

Show the specimens of loaf and moist sugar, both of which are of course quite familiar to all children. Tell that sugar is one of the commonest articles to be seen on the table at meal-time. Let the children themselves enumerate some of its uses. Remind them that the sweets which they love to buy at the confectioners' shops are all made of sugar. Let us see what we can learn about sugar to-day.

II. PROPERTIES

Hand a few pieces of loaf sugar round the class, and on similar lines to those laid down in the last lesson, proceed to elicit the simple properties of the new article. The children will be readily made to tell that, like salt, it is a **hard, white, opaque, solid substance**.

Compare the piece of sugar with a similar piece of salt. Sugar has a more **sparkling appearance** than salt.

Strike the two pieces with a hammer. The sugar is **harder** than the salt; but both are **brittle**; both break up into pieces with a blow; both **crumble into powder** when two pieces are rubbed together.

How would you be able to tell a piece of loaf-sugar from a piece of salt in the dark? We could tell by **tasting them**. Sugar is sweet.

You told me just now that you put sugar in your tea and coffee to sweeten them. What becomes of the sugar? It **dissolves**.

Very well; I have a tumbler of water here. I want one of you to come to the front, and show me exactly what this word—**dissolve**—means.

Let the child herself put one or two pieces of sugar into the tumbler of water, and stir it up till the sugar has all disappeared.

N.B.—Warm water will be best for the purpose, as sugar dissolves more easily in warm than in cold water.

Now tell me what has happened to the sugar? It

has been dissolved in the water, just as it is dissolved in tea or coffee.

- What does that mean? The water has broken up the sugar into such tiny pieces that they are too small for us to see.

How could you find out whether the sugar is in the water now? If we taste the water we shall find that it is sweet. The sugar has made it sweet. The sugar makes our tea and coffee sweet.

III. WHAT SUGAR IS

Give one of the children a fresh green leaf of some sort (a cabbage-leaf will do as well as any), and let her squeeze it in her hands. This done, call attention to the watery juice which she has pressed out of the leaf.

Tell that the leaves of all plants contain juice of some sort—that not only the leaves, but every part of the plant contains this juice. It is called the sap.

In some plants the sap is very sweet. It is the sweet sap or juice which makes all kinds of fruit so delicious.

Why should the juice of a ripe apple or plum be sweet? I will tell you. It is sweet because it contains sugar; and whenever the sap of any plant is sweet, it is sure to contain sugar.

All sugar is made from the sweet juices of plants. Nearly all the sugar we use is made from the juice of a plant called the sugar-cane.

We are now going to learn something about this plant.

IV. THE SUGAR-CANE

Show a picture of the sugar-cane. Elicit from the class that this plant is not like any we see growing here. Explain that it does not grow in our country, but only in very hot lands across the sea.

Point out the tall, straight stem, and tell that it grows

from 8 to 12, and sometimes to 20 feet in height. See that the children form a correct notion of these and all measurements, by comparing them with things around.

Notice next the knots or joints in the stem, and the long, broad, ribbon-like leaves, which grow out from them.

Tell that the sugar-cane, like all other plants, contains juice or sap. The stem itself is full of sap.

Now think for a moment of what we said about the apple and plum just now. Would you like to eat a green plum? No.

Why not? Is there no juice in it? Yes, there is juice in it, but the juice is not sweet—it is very sour.

When does it get sweet? It gets sweet when the fruit is ripe.

Why is the juice sweet then? Because it contains sugar.

Now think of the juice in the stem of the sugar-cane. There is always plenty of juice there, but it does not become sweet till the canes are quite ripe. It is sweet then because it is full of sugar. It smells and tastes very much like a sweet apple. This is the time to collect the juice. Let us see how it is done.

Show a picture of the sugar-harvest. Describe briefly how the canes are cut down, divided into short lengths, and carted away to the sugar-mill.

Next show a picture of the mill. Tell that in the mill the canes are crushed between heavy iron rollers, to press out all the juice, which flows away into great tanks placed underneath to receive it.





V. HOW THE SUGAR IS GOT FROM THE JUICE

This must be told in a very simple way here. The principle involved will be dealt with experimentally (and will therefore come more naturally) in the corresponding lesson in the second course.

Tell that the juice is boiled in great pans; that the watery part of it boils away, just as we see the water in the kettle boil away; that the sugar which is left behind gets thicker and thicker; and that at last when it cools it forms into little solid grains. That will be sufficient for the present.

Show some coarse, brown, moist sugar, and tell that this is what all sugar is like at first.

In this state it is called **raw or moist sugar**. Some of it will not form into grains, but remains a **thick, brown liquid**.

It is all put together into large casks which have a number of holes in the bottom, and the thick, brown liquid gradually drains away from the sugar, through the holes, into vessels placed beneath. We call it **treacle or molasses**.

Lesson XIII.

LOAF-SUGAR

Specimens of loaf and moist sugar, some powdered charcoal, a-jug of warm water, a piece of flannel, two or three tumblers, three or four flannel bags, a small flower-pot, and a piece of sponge should be provided.

I. INTRODUCTION

COMMENCE with a brief recapitulation of the last lesson.

Lead the children to tell what they know of the sap of plants. All plants have sap; there is sap in every part of a plant. Sugar is made from the sweet juice or sap which fills the stem of the sugar-cane. The juice of the ripe canes is full of sugar.

Let them tell briefly of the sugar-harvest, and describe how the sugar is obtained from the sweet juice by boiling.

What kind of sugar is it that comes from the juice? Coarse, brown, moist sugar.

II. MOIST AND LOAF-SUGAR

Set the moist and loaf sugar side by side, and lead the children to compare them.

First let one of them pick up a piece of the loaf-sugar in her fingers. Point out that she can do it easily; because it is all in one solid lump.

Let her next try to pick up some of the moist sugar in the same way. She cannot do it, because this is all in little loose grains like grains of sand.

Break off some small pieces of the loaf-sugar, and show that this, too, is in grains, but the grains are massed close together, and hold fast to one another in a solid lump.

What else can you find to tell me about the two things by looking at them? The moist sugar is brown, the loaf-sugar is white and sparkling.

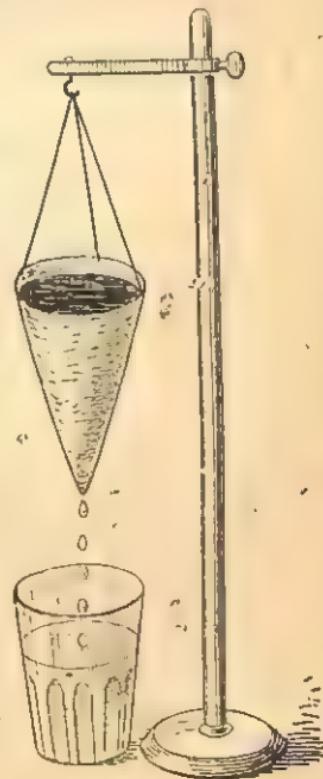
Quite right. See, I will dissolve some of each kind in water and make a syrup. The syrup made of the brown sugar is thick and of a dirty brown colour; that made from the white loaf-sugar is clear and almost colourless.

Explain that it is only dirt and other impurities which give the moist sugar its brown colour. The coarse, brown, moist sugar is changed into white, hard, sparkling loaf-sugar by getting rid of the dirt. We will see how this is done.

III. AN EXPERIMENT

Hold up a piece of flannel to the light, and call attention to the fact that it is full of little holes.

Produce the flannel bags. Place them one inside the other,



and pour^o some water into the inside bag, calling upon the children to notice how it trickles through the little holes, and falls into the basin drop by drop.

Now, pour some dirty, muddy water into the bag, and call attention to what happens. The water trickles through the flannel cloth again, but it is not the same muddy water as was put into the bag. It is much clearer. What does this mean? Explain that the holes in the cloth are too small to let the mud pass through them. Only the clear water drips through; the mud is kept back.

N.B.—This simple fact is all that need be told now. Porous bodies and filtering will be more fully dealt with in the corresponding lesson in the second course.

IV. REFINING THE SUGAR

Now let us see what all this has to do with our lesson on sugar. The sugar which comes to this country is the coarse, brown, moist sugar just as it leaves the boiling-house. It contains, as we have seen, dirt and other impurities which are not found in white loaf-sugar.

In the factories this coarse sugar is mixed with warm water into a syrup, like that which I showed you just now, except that a little lime is added to it, and the mixture is poured into bags made of thick woollen cloth, and left to drip through into a vessel below.

The syrup which is put into the bags is thick and of a dirty brown colour, because of the dirt and other impurities it contains. When it drips through the holes in the bags it is quite clear. The woollen bags form a strainer, and all the dirt is kept back in them, just as the mud from our muddy water was kept back in these bags.

Explain that the liquor which drips from the woollen bags, although clear, is still brown. The next business is to get rid of this brown colour. Tell that this is done by passing it through a bed of charcoal made from burnt bones. The charcoal takes away all the colour, and when the liquor runs out it is quite clear and colourless.

Illustrate by filtering some coloured water through a flower-pot half filled with powdered charcoal, and let the children see that the water is clear when it drips through the hole in the bottom.

N.B.—The hole itself should be plugged up with a piece of sponge before the charcoal is put into the flower-pot. Of course, no mention will be made of the terms **filter** and **filtering** at this stage. The illustration will be quite sufficient now. It will be referred to in the next course, when the children have been taught the nature of porous bodies. Then will be the time to give the names.

The clear, colourless syrup, as it flows out from the charcoal bed, is put into large copper pans, and boiled. The water, of course, boils away, and the syrup gradually gets thicker and thicker.

When it is thick enough it is poured into **large moulds** to cool, and at last it comes out of the moulds as a **hard, white, glistening sugar-loaf**, such as we see in the grocers' shops.

Explain that the sugar-loaf moulds are always stood with the small pointed end downwards. In this end there are some small holes, and as the sugar cools part of the syrup, which will not harden and become solid, drains through them into a vessel placed beneath. This is the clear bright kind of treacle known as golden syrup.

Lesson XIV

TEA

Articles required for illustration: some dry tea in a bottle, powdered chalk, blotting paper, a few fresh gathered holly, laurel and ivy leaves, and a few withered wilted leaves from the garden, a kettle of boiling water, a cup and saucer, two or three tumblers, a picture of the tea-plant.

I. INTRODUCTION

WHEN mother lays the table for dinner she places a glass

by the side of each person's plate. Why do we want a glass as well as a plate? We have to drink as well as eat at our meals. The glass is to hold the water for us to drink.

• Think of your afternoon meal. Do you see glasses on the table then? No, we have cups and saucers then instead of glasses.

What do we drink out of our cups at this meal? We drink tea.

Well, almost all grown-up people do, and that is why the meal itself is always called "**Tea**." But I think I told you once before that tea is not the best thing for girls and boys to drink. A cup of warm milk would do children much more good than tea.

Remind the children that no other thing, which we eat or drink, gives its own name to any of our meals as tea does, and so lead them to see that this must be a very important article indeed. If they ask mother, they will find that she would rather do without anything than her cup of tea. Let us learn now what this useful tea is.

II. A CUP OF TEA

Put a small spoonful of dry tea into a cup, and pour some boiling water on it, calling upon the children to describe what takes place. They notice that the water at once begins to change colour, and after a time gets quite brown. Remind them that this brown liquid is the tea which we drink at our meals. We will begin by finding out what we can about the liquid itself.

First as to the colour. You saw the water as it was poured out of the kettle. It was quite clear and colourless then, as all water is. The brown colour came after the water was poured on the dry tea in the cup. It must have come from the tea.

Put a little powdered chalk into a tumbler, and pour some water on it. Show that the chalk turns the water white at first,

but that in a short time the chalk all settles at the bottom of the glass, and the water becomes clear once more.

Point out, at the same time, that the tea in the cup is still brown as it was at first. Pour it into a tumbler without disturbing the leaves in the cup, and call upon the children to notice that it will stand as long as we wish in the tumbler without leaving anything to settle at the bottom.

Now let us see what all this means. I think you can tell me why the chalk sinks to the bottom of the water. Chalk will not dissolve in water.

Quite right; and now you must try to remember why there is no heap at the bottom of the other tumbler. Whatever it is that has soaked out of the tea into the water is dissolved in it. It will remain in the water; it would never sink to the bottom, because it is dissolved.

Now take the tumbler in your hand, and smell the tea in it. You find that it has a very pleasant smell, which of course was not in the water itself.

Now sip a little of the tea, and tell me what you notice. It has a pleasant taste as well as a pleasant smell.

Unwrap the bottle of dry tea, and hand it round for the children to smell it. Of course they at once detect the same pleasant aroma as they noticed in the infused tea in the tumbler. Let them take a few grains of the dry tea in their mouths, and then lead them to tell all about it in their own way.

III. WHAT TEA IS

We have done with this brown liquid tea in the tumbler. Let us look into the cup and see what we have there.

Empty the cup into a saucer, and let the children themselves examine what they find there. It would assist them in their investigation if the teacher selected a few of the best specimens

from the saucer, and spread them out carefully on a sheet of blotting paper.

Now think for a moment, and tell me what mother calls these things when she empties them out of the tea-pot after tea. She calls them **tea-leaves**.

Of course she does, and if you look at these on the blotting paper you will find that they are really leaves, although they are **brown**, and **not green** like the leaves which you see.

The tea-leaves, which we empty out of the tea-pot, as well as the fresh tea which we buy from the grocer, **were once green leaves**, and grew on plants just as other leaves grow.

IV. THE TEA-PLANT

Show a picture of the tea-plant. Tell that it is a small plant, about as big as a **currant or gooseberry bush**. It bears **long, oval, pointed leaves**, and pretty white and yellow flowers. The young leaves are never allowed to grow more than **2 inches long**, but they would grow to 4 and even 5 inches in length.

Lead the children to think about the trees and bushes as they appear in the winter-time. They have no leaves then; their leaves all fall before winter comes. Show sprigs of **holly, laurel, and ivy**, and let the children tell their names. Lead them to tell that we use these green leaves to brighten up our homes at Christmas-time. Explain that these leaves are green in the woods, and fields, and gardens, when there are no leaves at all on other trees and bushes. The plants on which they grow are always covered with green leaves all the year round. We call them **evergreens**.

Look again at the leaves. Notice that they all have a smooth, glossy surface, very different from the leaves of most other plants.

Tell that the tea-plant is an **evergreen**, and that its leaves are a bright, glossy green. Call attention to the jagged, saw-like edge of the leaves in the picture.

Explain that the leaves are the only useful part of the plant. The flowers, although very bright and pretty, are of no use.

We have to be content with a picture of this plant. I cannot show you a real one, for the tea-plant would not grow in our country. It grows in some hot lands far away across the sea.

In those hot countries hundreds of tea-plants are grown side by side in the open fields.

You would perhaps think

they must look very pretty, but I don't think they do, because the people pick off the young leaves almost as fast as they grow.

All through the season they go from plant to plant, picking the young tender leaves as soon as they burst open. These leaves make the tea which we buy in the grocers' shops.

Show the dry tea once more, and point out that this does not look at all like a heap of leaves. The children might be led to form a very good idea of what has been done to these leaves, if a few small wilted leaves from the garden were employed for illustration. Some of them should be shown rolled up tightly into a little ball.

Tell that the green leaves, as they are picked from the tea-plant, have neither taste nor smell; they would be of no use at all. They have to be roasted in pans over a hot fire, and afterwards rolled up by the hand into a sort of ball while they are still warm.

They get their pleasant smell and taste by being roasted.

Promise that some day we will find out how this is done.



Lesson XV

COFFEE

Provide some ground coffee, raw and roasted coffee beans, a few laurel leaves, a cup and saucer, a kettle of boiling water, a coffee-pot, a small coffee-mill, a picture of the coffee-tree.

I. INTRODUCTION

Show some ground coffee. Without saying what it is, hand it round the class in a small saucer, and lead the children to find out all they can about it from their own observation. Their eyes will tell them that it is a **brown powder**. If they smell it they will at once know what it is, from its **well-known pleasant aroma**; and if they put a pinch of it on their tongue they will find that it has a **pleasant taste** as well as smell.

Put a small spoonful of the powder into a cup, and pour on it some boiling water from the kettle.

What have we got now? A cup of hot coffee.

You saw me pour the water out of the kettle into the cup. What colour was it? It was quite clear; it had no colour.

Then the brown colour must have come from the brown powder which I put into the cup.

Now hand the cup round, and see what else you can find out about this steaming coffee.

Lead the children to tell, by smelling and tasting the coffee, that it has **the same pleasant smell and taste as the dry powder which they first examined**.

Now, I want you to try and tell me exactly what has happened since I poured the boiling water on the dry coffee powder in the cup. The boiling water **has dissolved the coffee**.

Quite right. The brown colour and the flavour both soak out of the powder, and are dissolved in the hot water to make a pleasant drink.

Does mother make the coffee in this way at home? No, she makes it in a coffee-pot.

Look once more at the coffee in the cup, and tell me whether you would like to drink it.

Lead them to point out that some of the grains of the coffee powder are floating on the top, and that this would make it very unpleasant to drink.

Show a small coffee-pot with a muslin strainer. Explain the use of the strainer. The muslin of which the bag is made is full of small holes, and when the coffee powder is put into it, and boiling water poured on it, the grains of the coffee are kept back, and only the water is allowed to pass through with what it has dissolved out of the coffee.

II. THE COFFEE-BEANS

Show some roasted coffee-beans in a saucer. Let them be passed round the class, so that the children may detect the same fragrant smell in them as in the coffee powder. Tell their names—**coffee-beans**; and lead the children themselves to suggest that the powder is made by **grinding these beans in a mill**.

If possible have a small, household coffee-mill at hand, and grind some coffee in the presence of the children.

Now produce the raw, unroasted beans, and have them handed round the class for inspection. The first thing the children will detect will be the absence of the fragrant smell which they noticed in the other beans. Let them take one of the beans in their mouth. It has no taste, not even when they break it up between their teeth. Here is a curious fact, and one which is sure to excite their curiosity.

Let us find out what all this means. The beans in the first saucer had the same fragrant smell and taste as the ground coffee itself. **These have neither taste nor smell.**

Think for a moment about our lesson on tea. What do you remember about the leaves when they are first picked? They have neither taste nor smell.

Quite right. When does the tea get its well-known smell and taste? **After it is roasted.**

Exactly; and it is the same with the coffee-beans. Those that I showed you first had been roasted; the roasting brought out their flavour. These have not been roasted—they are quite raw—they have neither smell nor taste.

Some day we will learn how this roasting is done, but I want first to tell you what these coffee-beans are, and where they come from.

III. WHAT COFFEE IS

Let the children once more examine the coffee-beans. Point out that each bean is flat on one side and rounded on the other. Let them put two together with the flat sides touching, and explain that they are the seeds of a tree—the coffee-tree. Show a picture of the tree and describe it briefly.



are long, oval, pointed leaves, of a bright, glossy green colour. Show a few laurel leaves.

The tree grows as high as two very tall men could

The coffee-tree does not grow in this country, but in hot lands far away.

Like the tea-plant it is an evergreen. What does that mean? An evergreen is a plant that is always green. It does not lose its leaves in the winter as other plants do.

The leaves of the coffee-tree are very much like those of the laurel; they

reach, if one stood on the other's shoulders, for its usual height is about 12 feet. It bears pretty white flowers, not unlike those of our cherry-tree, and when the flowers fall off, they leave behind a small red berry, which is very much like a cherry.

But the berry, instead of having a stone with a kernel inside, has two oval seeds—the coffee-beans.

Lesson XVI

COCOA

Teacher will require a packet of cocoa, some chocolates, a specimen cocoa-pod, and cocoa-nibs, a cocoa-nut, a cup and saucer, a kettle of boiling water, a hammer, pictures of the cocoa-tree and the cocoa-nut palm.

I. A CUP OF COCOA

THERE is another pleasant hot drink which we sometimes see on the table at meal-time, besides tea and coffee. Who can tell me what it is? Cocoa.

Yes, suppose we make a cup of cocoa now; and then we will try and find out all we can about it. I have only to pour some boiling water on a little of the brown powder from this packet, and stir it up with a spoon, and our cup of cocoa will be ready for use.

Hand the cup round the class, and let the children notice the fragrant aroma. Pass the packet of cocoa round next, and they will at once detect the same pleasant odour as in the steaming liquid in the cup.

Let them test the two by tasting, and they will find that it is the same.

The fragrant smell and the delicious taste both come from the powder in the packet. The boiling water draws the flavour out of it, just as it draws the flavour from tea and coffee.

Pour some of the liquid out, and notice that it is not quite

like tea or coffee in appearance, for instead of being thin and clear as they are, it is thick—almost like gruel.

II. COCOA—WHAT IT IS

Put some of the dry cocoa into a saucer, and let the children examine it. It is a powder, but not a coarse powder like coffee. It is very fine, and if they rub it between the finger and thumb they will find it is very soft and smooth.

Empty the cup, and show that the powder is all dissolved—there are no coarse, thick grounds at the bottom of the cup, as they would find if they made a cup of coffee in the same way.

Now let us see what this cocoa is, and where it comes from. But before I tell you what it is I will tell you what it is not. Cocoa is not made from the cocoanuts which we see in the fruiterers' shops.

Show a cocoa-nut, and, if possible, the outer husk in which the nut grows. Break the shell of the nut and show the white kernel inside. Tell that this is the only part of the nut which is eatable; all the rest is hard woody matter. The cocoa in our packet is not made from any part of this nut.

It would be well also to show a picture of the cocoa-nut palm itself. Tell that it does not grow here, but only in very hot lands across the sea. Point out that it is not at all like the trees which we see growing here. It is called a palm. It has no branches like other trees have—only some very large leaves at the top of the tall straight stem. Notice the cocoa-nuts growing at the top of the stem.

Now show one of the pods from the cocoa-tree. Let the children take it in their hands and examine it. It is a hard, rough, woody case. If they shake it they will hear something rattle inside.

These pods grow on a tree called the cocoa-tree. Here is a picture of it. You see it is a different kind of tree altogether from the cocoa-nut tree. That is a palm; it has a tall straight stem about 100 feet high, and no branches growing from it—only leaves at the top.

The cocoa-tree is about the size of our cherry-tree.

It has branches like other trees. The pods grow on the lower branches, and also on the stem itself, as you may see by looking at the picture. The cocoa-tree, like the coffee-tree, can only live in very hot lands, so that we do not see it growing here.

Produce the other pod, which has been cut open. Take out the beans and let the children examine them. Lead them to tell that they look like smooth brown nuts or seeds.

Explain that they are really seeds—the seeds of the cocoa-tree.

Each pod contains from twenty to forty of them. They are called **cocoa-beans**, and it is from them that our cocoa is made.



III. THE BEANS MUST BE ROASTED

Hand the beans round again in a saucer, and ask the children to smell them. They will detect no smell in these raw beans.

Break up one of the beans into small pieces, and have them tasted. They find them equally without taste.

These cocoa-beans, you say, have none of the taste or smell of the cocoa in this packet. What does that mean? Think of the coffee-beans in our last lesson, and you will understand it all. The coffee-beans have to be roasted to bring out their flavour.

Quite right; and it is exactly the same with these cocoa-beans. They have no flavour at present; they get their flavour by being roasted.

Show a packet of chocolates. Let the children tell what they are, and where we buy them. Tell that these chocolates are a favourite sweetmeat with everybody because of their delicious flavour. Chocolate is the best kind of cocoa ; it is made from these same tasteless cocoa-beans.

Lesson XVII

THE DINNER-TABLE

Have in readiness for the lesson the toy-table and table-cloth, the doll's dinner-service, knives, forks, and spoons, tumblers, a jug of water, salt-cellars and cruet.

I. INTRODUCTION

COMMENCE with a little chat about home. Mother has many things to do. Girls should try to learn, as soon as they can, how to help her.

There are many ways in which even little girls can soon learn to make themselves very useful ; and in time mother will feel that she would hardly know how to do without her little helpers. They might help her to lay the table for meals, to clear away when the meal is over, to wash up the tea-things, and to do many little things besides.

II. HOW TO LAY THE DINNER-TABLE.

1: The table-cloth.—We are going to learn now to lay the dinner-table. I think you will best remember all about it if we do it here with dolly's dinner-table.

Mary shall come to the front first and arrange the things on the table, and then I will call upon a few of the best girls to come out and do it afterwards. She will only do what we tell her ; I shall want to see how far you yourselves can help her without me.

Have the toy-table placed on the middle of the schoolroom table, or on something where it will be convenient for the children

to see and reach. The various articles required should be stood in readiness on a side table close at hand.

Now, girls, we are ready to begin. Tell Mary what she must do first. She must lay the cloth.

Where would you expect to find the cloth if you were going to lay the table for mother? In the drawer.

Yes. Everybody likes to see a nice, clean white table-cloth at meal-time. That is why, when dinner is over, mother always brushes the crumbs carefully off the cloth, folds it up neatly, and puts it away in a drawer, to keep it from the dust and dirt till it is wanted again.

Produce the cloth, and show the child how to spread it neatly on the table.

Explain that, in laying the cloth at home for mother, they must take care that it does not hang too far down on one side, or somebody's foot may catch it, and drag it off the table, with plates, dishes, and all.

2. **The knives, forks, and spoons.**—Now, girls, what must Mary do next? She must set out the knives, forks, and spoons.

Suppose she is going to lay the table for four persons—father, mother, and the two children. How many knives will she want? Four.

How many forks? Four.

Very well. Now tell her how to place them. She must set a knife and a fork for each person—the knife must be on the right, ready for the person's right hand, the fork must be on the left.

Quite right. See if you can put them all in their proper places, Mary.

In going round to the different places at the table, it is quite likely the child will get into a muddle somewhere. This will give an opportunity for the teacher to call upon one of the others to put her right.

Now we have the knives and forks placed at last. Look in the knife-tray, Mary, and you will find some smaller forks and some spoons. These will be wanted for the pudding. Lay them side by side in front of each person's plate.

Then, too, father will want the large knife and fork to cut up the meat. Do you know what we call them? We call them the **carving knife and fork**.

Why? Because they are used to **carve**, or cut up the meat.

What must we have to serve out the gravy? The **large table-spoon**.

Show how to place the *carving knife and fork in front of the carver, by the side of the smaller ones already set out, and put the table-spoon so that it will be ready to hand when required.*

The **spoons** for serving the vegetables should be placed side by side at the corners of the table.

Remind the children that all these things ought to look clean, bright, and shining. Dirty knives, forks, and spoons do not look at all nice.

3. Vessels for drinking.—Who can think of the next thing to go on the table? We must have **glasses** to hold the water for drinking.

Of course; and we must also have a jug of nice, fresh, clean water.

Tell that children must be very careful in pouring the water into their glasses at dinner-time, or they will spill it on the nice clean cloth. That makes mother angry.

The glass should never be filled with water up to the top.

Tell, too, that it is wrong to drink very much water at our meals.

III. DINNER

N.B.—It would be well to make a list on the black-board of the articles named as they are enumerated.

Dinner is the chief meal of the day. We eat more food at dinner-time than at any other meal. I want you to think, and tell me some of the things we have on the table to eat at dinner. We have **meat, potatoes, greens, and pudding**.

What do we sometimes have instead of meat? **Fish.**

Quite right ; and what does mother get, as a treat at Christmas time, instead of the usual joint ? **A goose.**

What is a goose ? A goose is a very large bird.

Do you know any other large birds whose flesh we eat ?
Fowls, ducks, and turkeys.

Fowls are very useful, too, while they are alive. If you think for a moment you will easily tell what I mean.

Fowls lay eggs.

Certainly ; and eggs are a very important article of food. We boil them and eat them as they are, and we put them into our cakes and puddings.

There is something which all children like to see at dinner-time, but they cannot get it in the winter. What am I thinking of now ? **Fruit pies and puddings.**

Yes, fruit comes in the summer. It is a delicious kind of food ; everybody is fond of fruit. We eat it raw, and we make it into pies, tarts, and puddings.

Think for a moment, and tell me what we use instead of fruit in the winter time when all the fruit is gone. We have **jam** instead of fruit then.

Quite right. You see we have got a good list of articles which appear on the dinner-table. But we have missed something which is never left out at any of ~~our~~ meals, although we take only a very little of it. What do I mean ? **Salt.**

Yes, I was thinking of salt. How do we place the salt on the table ? We crush it up to a powder and put it in the **salt-cellars**.

How do we help ourselves to salt ? We help ourselves with the small **salt-spoon**.

Show the ~~the~~ salt-cellars and spoons, and have them placed on the table, with the cruet for mustard, pepper, and vinegar, ending up with a few words about each if time permit.

Lesson XVIII

MEAT FOOD

I. INTRODUCTION

COMMENCE by calling upon the children to enumerate the various articles of food which have been dealt with in the preceding lessons. Write the names on the black-board as they are given, and proceed as follows:—

Let us begin our new lesson by picking out some of these articles—tea, coffee, cocoa, sugar, and the flour which we use for bread, cakes, and puddings. We will place them in a list by themselves.

Think of these articles one by one, and tell me what they all come from. They all come from plants which grow in the ground.

Quite right; and now I want you to learn another name besides plant for the things that grow in the ground. We call them all vegetables. A great tall tree is a vegetable; the green grass is a vegetable; every plant that grows is a vegetable.

We say that tea, coffee, cocoa, sugar, and flour are vegetable foods because they come from plants or vegetables.

Write the name vegetable foods over the list of articles.

There is one article among those you first gave me which comes from the ground, but not from a plant. It is found in the earth, like chalk, sand, and stone. Which is it? Salt.

What shall we say about salt then? Salt is a mineral.

Yes. I will write down salt by itself, and call it a mineral food.

Now let us think about the remaining articles—milk, butter, and cheese. Where do they come from? They come from the cow.

The flesh, if we put these things in another list by themselves, what shall we call them? We may call them **animal foods** because they come from an animal.

II. MEAT IS ANIMAL FOOD

Now think of the table at dinner-time, and tell me some of the things we have for dinner. We have meat, pudding, potatoes, and greens.

Would you call any of these animal food. Meat must be **animal food**, for all meat is **the flesh of some animal**.

Then suppose we add meat to our list, and you shall tell me the names of the animals whose flesh we eat. We eat the flesh of **the cow, the sheep, and the pig**.

Quite right; and remember the flesh of all these animals is called **meat**. If you told me you had had some meat for dinner I should not know whether it was the flesh of the cow, the sheep, or the pig, for they are all meat.

**Lead the children in this way to see why we have a particular name for each kind of meat, and let them give each name, the teacher assisting where necessary.*

What do we call the flesh of the cow? We call it **beef**.

What is the young cow called? It is called **a calf**.

What name is given to the flesh of the calf? **Veal**.

What do we call the flesh of the sheep? **Mutton**.

What is the name for a young sheep? **A lamb**.

Do you know what we call the flesh of the lamb? The flesh is called **Lamb** too.

What is the flesh of the pig called? It is called **pork**.

Meat, then, is the flesh of the cow, the calf, the sheep, the lamb, and the pig.

III. FRESH MEAT

When mother wants meat where does she go to buy it? She goes to the **butcher's shop**.

Where does the butcher keep the meat? He keeps it hung up on hooks round his shop.

How does he get the meat? He has to kill the animals, and cut them up into pieces.

Explain that he has to keep the meat hanging in the air to prevent it from going bad. Meat will not keep long after it is killed. In the hot summer weather it goes bad very quickly.

Think of the joints of meat as you see them in the shops. Part of the meat is **red**, and part **nearly white**. What is the red part called? **Lean meat**.

What is the white part? That is **fat**.

What does mother do with the meat to prepare it for dinner? She cooks it.

How does she cook it? She **roasts** it before the fire, or **bakes** it in the oven, or **boils** it in the saucepan. Sometimes she **fries** it in the frying-pan.

Why does she always cook the meat? Because the meat is raw when it comes from the butcher's shop, and **raw meat is not good to eat**.

IV. DRIED MEAT

If you think for a moment you will remember that there is another kind of meat which we have not yet mentioned, but we do not buy it at the butcher's shop. Do you know what I mean? **Bacon**.

Yes, I was thinking of bacon. **Bacon is meat**, for it is the flesh of an animal. Who can tell me the name of the animal? **The pig**.

But you told me just now that the flesh of the pig is called **pork**. How can both be true?

Explain that the flesh of the pig when fresh killed is called pork. We see pork hanging up in the butcher's shop, as well as beef, mutton, veal, and lamb. These are all fresh meat.

Remind the children of what was said about **fresh meat**. It will not keep long—it soon goes bad, especially in the hot summer weather.

Lead them to think about the nature of salt. Why does the dairy-maid put salt with her **butter and cheese**? What would become of these things if she forgot to put salt with them?

Tell that it is just the same with meat. The butcher often puts his **beef and pork** into strong brine, and the salt prevents them from going bad; they will keep good for a very long time. We call this meat **salt beef** and **salt pork**.

The bacon which we see in the provision shops is **the flesh of the pig** too. The fresh-killed meat was first salted in strong brine, and afterwards hung up to dry in the smoke of wood fires. When it is quite dried, or cured, it is not at all like pork either in look or taste. We call it bacon. It will **keep for a very long time**.

Tell that the pig, as soon as it is killed, is cut into two halves, down the middle of the back, and then **salted and dried**. We call the two halves of the animal **fitches or sides of bacon**. The legs are cut off, and salted and cured by themselves. These we call **hams**.

Lesson XIX

EGGS

The following articles should be provided: eggs of various birds, a hen's egg and a duck's egg; a hard boiled hen's egg, a cup, a kettle of boiling water, a basin.

I. INTRODUCTION

Show as many specimen eggs as can be obtained, and proceed to elicit from the children what they can tell about them. These eggs all came from birds; all birds lay eggs. The little birds build their nests in the trees on purpose to hold their eggs.

Pick out the hen's egg, and lead the children to tell that this is a very common article of food. They see these eggs on the table boiled for breakfast, and they know that mother puts them into cakes, puddings, and custards. We do not eat the eggs of

small birds. This is called a hen's egg because a hen laid it, and a hen is a large well-known bird. Many people keep hens for the sake of the eggs they lay.

Lead the children to tell that, as the eggs come from the hen, and the hen is an animal, we must place eggs among our list of animal foods. Like milk, butter, and cheese, they are animal food, although they are not the actual flesh of an animal—they have never been alive.

II. PARTS OF THE EGG

1. The Shell.—Let us now examine the egg, and see what we can learn about it. In the first place, if we take the hen's egg and compare it with the others, we see that they are all very much alike in shape. We will deal with the hen's egg then, as that will show us all we want to know.

Now look at it. What shall we say about its shape?

Lead the children to tell that the egg is round, but not round like a ball, for it is longer one way than the other. Point out too that the ends are not both alike—one is broader and bigger than the other. That broad big end is almost round, but the opposite end is more pointed.

Tell that we have no better way of speaking about the shape of an egg than by saying it is egg-shaped. An egg has a shape of its own.

Let us next notice the colour of the shell. The colour of this one is white, but some hens' eggs are brown.

Call attention to the smaller eggs of the collection. Some are blue, some spotted, some marked with streaks of different colours. A duck's egg again is a dirty bluish-green colour. Show one if possible.

What would happen if I dropped one of our eggs on the floor? It would break.

Why would it break? Because the shell is very brittle.

Yes; the shell feels hard and smooth as we hold it in our hands, but it is very brittle. It breaks easily.

While speaking, give the egg a smart tap on the broad end, as if by accident, and show that the shell is broken with the blow.

Strip off the broken fragments of shell carefully, and let the children see how easily they break up in the fingers.

Explain that it is a good thing the shell breaks so easily, for we want to find out what is inside the egg.

2. The Inside.—Call attention to the thin, soft, smooth skin, which is seen when the pieces of shell are removed, and next proceed to break the egg into a cup.

Before we go on to examine what is in the cup, I want you to have a good look at the inside of the shell. That thin, smooth skin is not round the broad end of the egg only. We found it there when we broke the shell, but it lines the whole of the inside of the shell. See, I will tear it all away.

Do so, and let the children take it and examine it for themselves.

That will do for the shell itself. Now let us see what we have in the cup. You see the inside part of the egg is not all alike. There is a round, yellow ball in the middle, and that seems to float in something which looks clear like water.

Suppose we examine the yellow ball first. We call it the **yolk** of the egg. You cannot get a good look at this one, so I will show you another.

Produce the hard-boiled egg. Strip off the shell and cut through the solid white part carefully, so as to allow the yolk to roll out into a saucer. Hand it round for the children to examine.

Explain that this egg has been boiled, and that the boiling has made it **hard and solid**. Otherwise the yolk is the same as the raw one in the cup so far as its colour is concerned. Tell that the yolk is the **richest part of the egg**.

Call attention next to the thick, white, solid part of the egg which was stripped off all round the yolk. Compare it with the clear, watery-looking part of the raw egg in the cup. Tell that both are the same thing; but the boiling has

changed the clear watery liquid into that **tough, white, solid substance.**

Let the children dip their fingers into the raw egg in the cup, and show them that the clear, watery-looking part is not water at all. It is a **very sticky liquid**; it sticks to their fingers.

Empty the cup, while speaking, into a basin of boiling water, and point out the change that at once takes place. This clear, watery-looking liquid becomes a **thick white solid**. We call it **white of egg**.

This explains why the hard-boiled egg looked like a smooth, white ball when the shell was taken off. The clear, watery-looking part of the egg all round the yolk had been changed into this white, curdy, solid substance—**white of egg**.

III. WHY BIRDS LAY EGGS

I want you to think about the little birds in their nests among the trees. The mother-bird lays her eggs in the nest, but what does she do then? She sits close upon them for a long time to keep them warm.

When she has sat upon them long enough what happens? Little young birds come out of the shells.

Look at our hen's egg. What would have happened to this if the old hen that laid it had sat upon it and kept it warm? **A real live chicken** would have come out of it.

Quite right; and we say the old bird **hatches her eggs**. The chicken inside the egg is a very, very tiny thing at first—not bigger than a pin's head. All that white and yolk of the egg is simply a **store of food** for the little thing to live upon, till it is big enough to come out and begin life as a real chicken.

Lesson XX

POULTRY

Articles required, for illustration: a hen's egg, a tumbler of milk, pictures of fowls, ducks and geese.

I. INTRODUCTION

Show a hen's egg and a tumbler of milk, and make these the starting-point of the new lesson. Let the children tell whence these two articles of food are obtained, and so lead them to compare the hen and the cow.

The cow gives milk while she is alive, and her flesh provides meat-food when she is dead. The common hen gives eggs while she is alive, and her flesh too provides us with food when she is dead. Just as the cow is the most useful of all beasts, so the hen is **the most useful of all birds**.

Ask whether any of the girls have hens at home. There will probably be several in the class who have. Explain that all sorts of people, rich and poor alike, take pleasure in keeping fowls because they are so useful. The farmer's wife generally has hundreds of them. We sometimes speak of them as **barn-door fowls, and barn-yard fowls**, because they live in the barn and the barn-yard.

Lead the children to tell that these birds are quite tame: they run up to be fed when we call them, and are not at all afraid of us.

II. FOWLS

Show a picture of a group of fowls, and lead the children to talk about them.

What do we call that fine, handsome bird in the middle? He is **the cock**.

Notice his beautiful tail of long, curved, flowing

feathers. How proudly he holds his head too as he walks about! He is a very proud bird. How does he sometimes show it? He **crows.**

Yes; and he sometimes crows very loudly too. He likes to crow in the early morning, for he is a **very early riser.**

Now let us look at the hens. They are smaller than the cock, and not so handsome. They have no beautiful,



glossy, arched tail, but only some stiff, straight feathers. They do not crow; but we sometimes hear them making a **loud, cackling noise** in the morning. Can you tell me why they do this? They always cackle **when they have laid an egg.** They seem very pleased to tell us.

What do we call those pretty little fluffy things by the side of the hen? They are the **chickens.**

What do you remember from our last lesson about the little chicks? They come from eggs. The old hen **hatches them** by sitting upon the eggs and keeping them warm.

What is the old hen doing now? She is **scratching in the ground** with her feet.

Why do you think she is scratching in this way? She is searching for food for her chickens.

• What food can she find in the ground? She finds worms, grubs, and insects.

Do fowls have anything else to eat besides worms and insects? Yes; people who keep fowls feed them with corn, crumbs of bread, and scraps from the table.

Picture them as they come flocking up to be fed at feeding time. The hen clucks to call her chicks every time she finds a nice morsel. The cock, too, helps her to find food for them. He scratches away with his feet, and whenever he comes upon a tit-bit, instead of gobbling it up himself, he calls the hen and chicks to the feast.

See what strong-looking legs and feet the fowls have. They are made strong on purpose to do this work of scratching in the ground. The foot has three long toes in front, and one behind, and at the end of each toe there is a strong, curved claw.

These birds are called scratchers. Pigeons scratch in the ground for their food too, and so does that great strong bird the turkey. They are scratchers, like the fowls.

Lead the children next to tell how the fowls sleep at night. They rest on a perch in the hen-house; their long toes help them to take a firm hold of the perch. We call this roosting.

Now let us leave the feet, and examine the head. What do we call that piece of bright-red, wrinkled flesh on the top of the head? That is the comb.

Point out and elicit that the cock's comb is much larger and finer than the hen's. This and the pair of bright red wattles, which hang down on each side, help to make him a very grand-looking bird.

Point out that the head itself is very small; and lead the children to tell that the eyes are sharp and bright.

Notice the mouth next. This is formed by a short, hard, horny beak. Fowls, like all birds, have these hard, horny beaks instead of lips and teeth as other animals have.

What is the use of these hard, sharp-pointed beaks? Think of the fowls scratching in the ground, and you will be able to tell. They **pick up their food** with their beaks as they scratch it out of the ground.

Quite right; and they want their **quick, sharp eyes** to point it out to them. A worm is very sharp; it wriggles back into the ground very quickly. They would soon lose it but for those sharp eyes.

III. DUCKS AND GEESE

Show the picture. What are these birds? What do we call the male duck? What do we call the male goose?



Tell that fowls, turkeys, ducks, and geese are called **poultry**.

Their flesh supplies us with food when they are dead.

Lead the children to notice that these birds—ducks and geese—are **very different** in appearance from the cocks and hens we have just left.

Probably the first point they will notice will be the **broad, flat bill**. Explain its use. Tell that these birds, like fowls, are **very fond** of worms and grubs, but they get them **out of the water, and the mud at the bottom of the water**.

These broad, flat bills are like shovels. They shovel up the mud with them, and so get the grubs and worms they want.

As these birds find their food in the water, what must they be able to do? They must be able to **swim**.

Let this lead up to a simple explanation of the foot of the duck and goose. Explain the purpose of the webbed foot.

Could these birds find their food in the ground as cocks and hens do? No.

Why not? Their toes are not stiff and strong like the fowl's toes. They are not made for scratching.

Point to the duck in the picture. She waddles: she cannot walk. Her feet are made for swimming. She swims well; even the tiny ducklings can swim; but they only waddle awkwardly on the ground.

Tell that ducks and geese never roost on a perch as fowls do. They rest on the ground. Why is this?

Lesson XXI

FISH

Place on the table a fresh herring, a bloater, a kipper, a dried haddock, and a bowl of living fishes of some sort; and have in readiness pictures of the various common fishes, and of the flat-fish variety.

I. INTRODUCTION

COMMENCE by leading the children to name the different articles of animal food which have been dealt with in the preceding lessons.

We often see on the table another sort of animal food, which is neither meat, nor milk, nor eggs, nor poultry. Can any one tell me what I mean?

The children will probably fail here to recognise a fish as an animal. If so, show a herring or some other familiar fish, and remind them that fish is a very common article of food.

Lead them to tell that this herring was once alive; that

it lived in the water; that it could move about in the water as it pleased. Show, if possible, a bowl of gold-fish, or a few sticklebacks, and let the children observe these facts for themselves.

The herring and all the fish we see were once living, moving things like these fish in the bowl. Fishes must have food. They find their food in the water where they live. They have a mouth for swallowing their food; and it is their food that makes them grow bigger and stronger.

Elicit that the cow, sheep, pig, fowls, and ducks are like the fish in all these points, except that they do not live in the water.

What do we call cows, sheep, pigs, and birds? We call them animals.

Then what are fishes? **Fishes** must be **animals** too.

What shall we say about the fish that mother cooks for our meals? **Fish is animal food**; it is the body of an animal.

II. FISH FOR FOOD

*Lead the children to name the various kinds of fish to be seen in the fishmongers' shops—such as **herrings**, **sprats**, **mackerel**, **haddock**, **cod**, **salmon**, **whiting**, **soles**, **plaice**,—the teacher, of course, assisting where necessary. It would be advisable, if possible, to show pictures of these as they are named; and a list of them should be written on the blackboard.*

*Show a real **bloater**. This is so familiar to all that the children will have no difficulty in saying what it is.*

Let us examine this bloater. Which of the fishes in our list is the bloater most like? The herring. The bloater is a **herring**, although **blobsters** do not swim about in the water as the fish in our bowl do. How is this? Let us see.

If a fresh herring can be obtained, let it be shown now side by side with the bloater. Let one of the children take both in her hands.

What is the difference between the bloater and the

herring? The herring is wet; it wets our hands if we take it up. The bloater is quite dry.

- This herring is fresh, just as it came out of the water. The bloater was just like it once, but it was salted, and then hung up in the air to dry. Why was this done? Think about bacon; that will give you your answer. It was done to keep the herrings good.

Exactly. These wet fresh herrings would soon go bad, and be unfit for food. Like bacon they will keep for a long time after they are salted and dried. In this state we call them **bloaters** and **red herrings**.

Lead the children to tell that the herring, in this respect, is like the cow, the sheep, the pig, and the calf. These animals when they are dead have other names—**beef**, **mutton**, **pork**, and **veal**.

Show a "kipper." Fold the two sides together, and elicit from the children that this too is a **herring**. Lead them to tell what has been done to this herring to change it into a **kipper**.

Show a **dried haddock**, and point out that this fish has been treated in exactly the same way, and for the same purpose.

Explain that mackerel, cod, and salmon, as well as herrings and haddocks, are sometimes salted and dried. They are then sold as **dried fish**, and will keep for a long time.

Picture the fishmonger's shop. Lead the children to tell that a large part of the fish they see in the shop is sold just as it comes from the water, without being dried. Let them tell from their own observation, that the fishmonger usually has one side of his shop for dried fish, and the other for wet, fresh fish.

Tell that nothing goes bad so quickly as this wet fish. It then smells very unpleasant, and is quite unfit for food.

If the fish is quite fresh, the eyes will be **bright** and **glassy**, and the **gills** very **red** and full of blood. I will show you what the gills are, and then you will always be able to tell whether the fish is fresh or not, as you look in at the shops.

Produce the fresh herring once more, and call attention to the gills.

Nothing more need be said about them at this stage, except that they are for breathing. The fish breathes with these gills in the water.

It dies as soon as it is taken out of the water—it cannot breathe then.

We could not live in the water, because we have no gills. How do we breathe? Show, and explain briefly.

III. FISH ARE WATER ANIMALS

Return now to the picture. Let the children once more name the different fish on it.

Where do all these fishes come from? They come out of the sea.

Most of the fish we get to eat come out of the sea; but some fish live in ponds and rivers. Who can tell me the difference between the water of the sea and that of ponds and rivers? The water of the sea is salt; the water of ponds and rivers is not salt—but fresh water.

Quite right; and we call the fish that live in ponds and rivers fresh-water fish, just as we might call all other kinds salt-water fish.

Picture the fishermen in their boats out at sea. Describe, in a simple way, the net, and the manner in which it is set and hauled in.

Tell that the salmon, although it lives in the sea, likes to swim up the rivers at a certain time in the year. This is the time when these fish are caught. They are caught with a hook and not with a net.

We started by saying that fishes are animals—they have to move about in the water. Think of the animals that you see moving about, and tell me another great difference between them and fishes. All the animals that walk and run about have legs; fishes have no legs.

Fishes have no legs, and yet they can move about easily enough in the water. Let us see how this is.

Point out the tail and fins. Show how flexible the tail and fins of the fresh herring are. The fish can move them about just as it pleases. Tell that the fish uses its tail to push itself along through the water, while the fins help to balance it and keep it from falling over as it swims.

Point out the peculiar form of most of the fish. The body is long, and narrow, and pointed at both ends. This makes it very easy for the fish to force itself through the water. Turn to the fish in the globe and show how swiftly they can dart from place to place.

Do you notice any fish in the picture that are not shaped like the rest? The sole and plaice are flat—not long and round.

Tell that we call these **flat fish**. They live on the sand at the bottom of the sea. They lie with their white side below, and the brown side uppermost.

Compare this brown side with the colour of the sand all round them, and tell the purpose of it. Even the eyes of these fish are turned out of the proper position. They are **both on one side of the fish.** Why? If they were not, one eye would be buried in the sand. They are placed so that they can see above them, and all round them.

Lesson XXII

SHELL-FISH

Specimen shells of the common shell-fish, a few snails, an actual oyster, or a picture of one opened, and a picture of a snail crawling, should be provided for illustration.

I. INTRODUCTION

Show specimens of as many of the common shell-fish as can be obtained, and commence by calling upon the children to tell the name of each, assisting them, of course, if necessary.

Now, look at this one, the **periwinkle**, and tell me whether you have ever seen anything like it before. The snail is like it, but it is bigger.

Where have you seen snails? In the garden.

Where would you look for snails in the garden? On the leaves of the plants.

Why there? Because **they eat the leaves** of the plants.

Yes; they do eat the plants; they are very hungry things. Look, I have two snails here—a large one, and a



tiny thing not much bigger than a pea. If we left this little one in the garden with the plants it would eat and eat till it grew as big as the other.

What does the gardener do to the snails when he catches them? He kills them.

Are they easily caught? Yes.

Why? Because **they only crawl about very slowly.**

Quite right. So now we have found out that the snail is a **living thing**, which eats, and grows, and moves

about from place to place. What shall we call it then? **An animal.**

- Yes; and the **oyster, mussel, whelk, and periwinkle** are animals too of the same kind. We have been talking about the snail, because that is an animal which we can watch and study for ourselves. Those others live at the bottom of the sea, where we cannot watch them. The **whelk** and the **periwinkle** are only sea-snails.

Now look at them all once more, and tell me in what point they are alike. They all have **hard, strong shells**.

Where do we buy them? We buy them at the fishmonger's shop.

Yes; and the fishmonger calls them **shell-fish**. But I want you to remember that **they are not really fish**, although we get them from the fishmonger's shop, and he gets them from the sea.

Now look at the shells of all of them again, and tell me in what way some are different from others.

Point out that the oyster, mussel, and cockle have a double shell; the two shells are joined together on one side by a sort of hinge, but the shell of the whelk and periwinkle is all in one piece.

II. THE OYSTER

1. The Shell.—*In actual shell, in its most perfect form, should be at hand for illustration. The structure of the animal itself (so far as it is desirable to deal with it) would be best shown on a picture. To get a shell suitable for the purpose it is only necessary to throw an oyster into boiling water. The heat will kill the animal, and the shell itself will open.*

Here is the oyster-shell; let us examine it. It is, as we said before, in two parts. Look at the two parts; are they both alike? No; one is **almost flat**, the other is **rounded** something like a saucer.

How are the two shells joined together? They are **joined on one side.**

Point out that the part where they are joined forms a sort

of hinge. Explain that when the animal is alive it can open and shut the two shells just as it pleases. •

Now, let us look again at the shell. What is it like on the outside? It is brown, and very rough.

What is the inside of the shell like? The inside is pearly white, and very smooth and shining.

Show the oyster itself. Lead the children to tell that this animal is unlike any of the animals of their former lessons. It has no bones of any kind; its body is soft. Tell that we



call it a soft-bodied animal. This will lead them to see for themselves the necessity of that smooth shell. The oyster lives all its life in the smooth hollow between the two shells.

2. **The soft body.**—Turn now to the picture. Explain that the animal is fixed to the inner side of each shell. It cannot leave the shell, because the shell is part of itself.

Think of the oyster, with its heavy shell covering, at the bottom of the sea. It cannot move about like other animals; it lies in that one spot all its life. When it was

very young it was a tiny thing, not much bigger than a speck of dust, although even then it had a perfect shell. It was then so light that it was able to swim about, but as it grew its shell became heavier and heavier, and at last it sank to the bottom never to swim about again.

There it lies all the rest of its life, opening its shells to feed and breathe, and snapping them together when any danger approaches, for it has many enemies among the other animals of the deep.

Rouse the curiosity of the children by telling them that this strange animal, although it must breathe and feed like other water animals, has no head. It has a mouth, which is placed near the hinge that joins the two shells. It uses its mouth for feeding purposes only. It sucks in the tiny animals that swim about in the water all round it. Point out the mouth in the picture, and the folds of the mantle which cover it.

Call attention to the fringe all round the edge of the mantle. Tell that these are the gills through which the oyster breathes.

Explain that the mussel, cockle, and scallop are very much like the oyster.

III. THE WHELK

Show a picture of the snail. Point out that as this creature moves along its body is half out of its shell.

The snail crawls along slowly on the broad, under part of its body, which we call its foot.

Whelks and periwinkles, like the snail, are able to move about also, although they live at the bottom of the sea. They are sea-snails.

Show, if possible, a picture of these animals crawling about.

The actual structure of the animals need only be lightly touched upon here. It will amuse the children to learn that the head of the whelk really forms part of its foot, that the tongue is armed with a hundred rows of teeth, which act like a rasp or file in tearing its food, and that the

animal itself devours as many other animals as the lion or tiger does in the jungle.

Lesson XXIII.

SHRIMPS, CRABS, AND LOBSTERS

Provide a picture of a crab and lobster, and if possible a good specimen of each, a few shrimps and prawns, and a picture of the lobster creel.

I. INTRODUCTION

COMMENCE by showing a picture of the crab and lobster. Let the children point them out by name, and say where they have seen them. Lead them to tell that, although crabs and lobsters are sold at the fish-shop, they are not at all like herrings, mackerel, cod, plaice, or any other kind of fish in the shop.

Explain that they are not real fish, although they are animals that live in the sea as fishes do. Point out that they have legs, as if they were meant to crawl about. Fish swim in the water, but they cannot crawl, because they have no legs. Crabs can move about very quickly on their long legs, and lobsters can swim as well as crawl. They use their tail in swimming.

Show a few shrimps next, and let the children compare them with the lobster and the crab. The shrimp looks like a very tiny lobster.

Explain that all three—shrimps, crabs, and lobsters—belong to the same class of animals. They all live in the sea, but they are not fishes. We will examine them, and see what we can learn about them.

II. THE OUTER COVERING

If actual specimens of the crab and lobster can be obtained let them now be handed round the class for inspection. The first thing to strike the children will no doubt be the hard case or shell, which covers the body and limbs of these animals.

What other animals have a hard shell to cover their body? Oysters, mussels, whelks, and all shell-fish.

What kind of bodies have these animals? They have **soft bodies**, without any bones.

Why do they want a shell? To protect their soft body. What kind of shell is it? It is a **thick, heavy shell**.

Where do these animals live? They live at the bottom of the sea.

How do they move about from place to place? They move very slowly, because of their heavy shells? Oysters and mussels do not move about at all, but are fixed to the rocks.

In this way lead up to the fact that limbs are not wanted in such animals. The shell of the oyster, mussel, and whelk forms a sort of house, in which the animal can shut itself up when danger approaches. It can draw its soft body up, so that every part of it is inside its house.

Now look at the crab and the lobster. Their long legs (and **they have ten of them**) are meant for work. They must not be shut up inside a shell, and yet they must be protected, for they too are **soft**, and **without bones of any kind**.

The hard covering of these animals is not a house, but a **tight-fitting coat**, which covers body and legs as well. It reminds us of the coats of steel armour which the fighting-men used to wear in battle hundreds of years ago.

Point out, too, that this coat is in separate pieces, and that the pieces are jointed together by a tough skin, which allows the limbs to move easily.

Hand a few shrimps round, and let the children see these movable plates for themselves. Compare them with those on the body of the lobster, and show that the arrangement is the same.

III. CASTING THE SHELL

The young crabs and lobsters grow very quickly, but the hard shell which covers them cannot grow. How would you feel if you grew too big for your clothes? We should feel very uneasy.

What would happen to the clothes themselves? They would **burst and split**.

Then you will easily understand what happens to the young crabs and lobsters. As they grow they get too big for their shell-coat, and after a time it **cracks and splits in all directions**, till they are able at last to wriggle out of it altogether.

But while they are getting rid of the old shell a new one is being formed in its place. This new shell is not hard at first, and until it gets hard they crawl away and **hide themselves** in holes in the rocks, for fear of the fishes and other creatures who would eat them.

When at last their new shell-coat is hard and strong they come out of the holes again. They are no longer afraid of the other creatures in the sea, for **that hard covering protects them** against all their enemies.

They **cast their shell many times** in this way while they are growing, and each time they find a new and bigger coat underneath.

IV. THE CLAWS

Call attention next to the two large, powerful claws in front. Each claw is in two parts, and forms a pair of nippers.

Show that it opens and shuts like real nippers or pincers. Tell that these nippers are enormously strong. It would be easier to tear away the claw altogether, than to make it unloose its grip when once it had taken hold of anything.

Crabs and lobsters use their nippers to **seize their prey**, and it is all over with their victim when those powerful nippers close together upon it. They feed mostly on mussels and other soft-bodied animals of the sea. **They crack the shells** with their claws, just as we crack a nut with a pair of nut-crackers, and the **teeth or notches** in the edge of each claw help in the work.

It would amuse the children to learn that these creatures are able, not only to change their small tight coat for a larger one from time to time, but also to renew their claws. Tell that

sometimes they have the misfortune to break off a claw. This, however, does not trouble them, for whenever it happens, a new one at once begins to grow, and they are soon all right again.

V. HOW THEY ARE CAUGHT

Crabs and lobsters are caught in curious-looking baskets called **creels** or **lobster-pots**.



Show a picture of one of these creels, and explain its construction.

The **creel** is made of wicker-work, and is open at the top for the crab to crawl in; but when once it is in, it cannot get out again.

Pieces of dead fish are put into it for bait, and it is loaded with a heavy stone, and let down to the bottom of the sea at night. In the morning when the fishermen pull up the **creel** they find the crabs and lobsters in it. They crawl in to get to the bait, but they cannot find their way out, and so they are caught.

Shrimps are usually found in the shallow water near

the shore. They are caught in nets which are dragged behind small boats called **shrimpers**.

They are also caught in **small hand nets**, which men push in front of them at the end of a long pole, as they wade through the water. The largest and best shrimps are called **prawns**.

Explain that shrimps, crabs, and lobsters require to be boiled when they are caught. Show the lobster once more. It is bright red now, but when it was alive in the water it was a bluish-black colour. It changed its colour when it was boiled. A painter who did not know this was once asked to paint a lobster swimming in the water. When people came to see his picture they all laughed at him, for he had painted his lobster red.

Tell too that although the shrimps which we see are **pink** or **brown**, they were a **greenish gray colour** when they were alive. It is a very difficult thing to see them, as they dart about in the little sandy pools on the sea-shore. What is the object of this?

Lesson XXIV

A BASKET OF VEGETABLES

The teacher will require two boiled potatoes, a raw unpeeled specimen, a turnip, a carrot, a radish, a potato growing out at the eyes if it can be obtained, and pictures of all the growing plants.

I. INTRODUCTION

COMMENCE by showing one or two boiled potatoes on a plate, and proceed as follows:—

“Do you of course know what these are, children? They are potatoes.”

Where did you last see potatoes like these? On the table at dinner-time.

Do you know what this is? (*Showing one fresh from the shop, raw and unpeeled.*) That is a potato too.

But this one is not like those in the plate. Can you tell me why? Those in the plate have been boiled; this one is raw.

Where does mother get the potatoes from? She gets them from the green-grocer.

What do we call the things she buys from the green-grocer? **Vegetables.**

Tell me the names of some of the vegetables besides potatoes, which you can see in the green-grocer's shop. Cabbages, peas, beans, carrots, turnips, parsnips, onions, radishes, lettuces, celery.

The teacher, of course, will assist where necessary in completing the list, and the names should be written on the black-board as they are given.

What does mother do with the vegetables to make them ready for dinner? She cooks them.

Yes; she cooks the potatoes, cabbages, peas, beans, carrots, turnips, and parsnips. We should not like to eat them raw; **they would not be good for us unless they were cooked.** When they are cooked we eat them with meat for dinner.

But there are **some vegetables** which are eaten raw, especially in summer time. We eat them with cold meat, and also with our bread and butter at breakfast and tea-time. Can you tell me any of them? Lettuces, radishes, celery, water-cress, and spring onions.

Where do all these vegetables come from? **They all come from plants** which grow in the ground.

Let us take them, one by one, and see what we can learn about them. We will begin with the potato.

II. THE POTATO

You told me the potato came from a plant, and you were quite right. But do you know from what part of the plant it comes? I will show you.

Set up in front of the class a good picture of the growing potato-plant, with a section of the soil showing the roots and

tubers. Let this latter part be covered up at first with a sheet of paper.

Call attention to the rest of the plant, which can be seen above the ground, and lead the children to describe the different parts—the green stems, the green leaves, the flowers, and the small, round, green balls that hang where the flowers have fallen off. Explain that these little balls are full of seeds—they are the seed-pods of the plant.

But where are the potatoes? We have not seen them yet. Let us see if we can find them.

Remove the sheet of paper, which till now has been hiding the parts below the surface of the soil; and let the children point out the potatoes.

They will, of course, say that these are the roots of the plants. Point out the actual roots. Show that they

are like the roots of some of the other plants which we have examined. They stretch down into the soil like long thin threads.

Explain that the potatoes themselves are not the roots; they are parts of the stem which stretch under the ground. We call them tubers.

Show the eyes in an actual potato. Tell that these eyes are buds, like the buds which swell and burst open on the trees in spring. If the season of the year permit, it would be well to show a potato "growing out" at the eyes. The real roots of plants never have buds like these.

Tell that when the potato-plant is fully grown the green stems all die down to the ground, and then is the time to get the potatoes and store them up for use. How do the men get the potatoes?



III. Roots

Here are some other vegetables which you know something about already. What is this? A carrot.

And this one? A turnip. And this? A parsnip. And this one? A radish.

Show, as before, pictures of the growing plants, with a section of the soil in which they stand. Point out that with



these plants, as with the potato, it is the part in the earth which we use for food.

What is this part of the plant? Is it the root? Let us see.

Think of the corn in the corn-fields. What kind of roots have these plants? Their roots are like little white threads which stretch down into the ground.

Yes; we call a root of that kind a fibrous root, because it consists of fibres or threads. Nearly all the flowers which grow in the garden have the same fibrous roots. What becomes of the flowers when the summer is over? They wither and die down.

Quite right ; and the corn plants in the fields would die down too if we left them. These plants live only one year. We call them **annuals**. All annuals have these **stringy, or fibrous roots**.

Carrots, turnips, parsnips, and radishes would not die when the cold weather comes if they were left in the ground. They would only **go to sleep**; they would **spring up again** when the cold was all gone. The thick solid part in the ground contains a **store of food**, which is meant to **feed the plant**, and keep it alive all the winter, till it can get its proper food again out of the soil.

The carrots, turnips, parsnips, and radishes which we see in the green-grocers' shops are the **actual roots of the plants**. We call them **fleshy roots** because they are thick and solid.

Lesson XXV

SOME OTHER VEGETABLES

Place on the table a potato, a turnip, some onions, a cabbage, one or two Brussels sprouts, a few pea and bean pods (dried specimens will do), and a knife. Have in readiness pictures of all the growing plants.

I. INTRODUCTION

Show a potato and a turnip, and commence by leading the children to recapitulate briefly a few of the main facts of the last lesson.

What do you see on the potato which you cannot see on the turnip ? The potato has "eyes"; there are **no eyes in the turnip**.

What does this tell you ? **The potato is not a root like the turnip.**

It is the underground part of the stem swollen up into **tubers**.

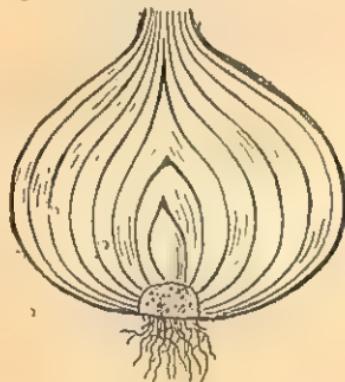
What do we call the thick, solid roots of the carrot and turnip? We call them **fleshy roots**.

Why do these plants have thick, fleshy roots? They are meant to live more than one season; these roots contain **food to feed the plants** in the winter, when they cannot get food from the soil.

• • • II. THE ONION

Here are some other useful vegetables. What are they? Onions.

Suppose I cut one of them up, and give each of you a



piece to eat. Would you like it? No.

Why not? Onions have a **very strong taste and smell**.

Yes; that strong, stinging taste would quickly bring the water to your eyes. Onions are not nice to eat raw, but they are good food when they are cooked. We use them mostly to **flavour other foods**.

Now let us examine the onion and see what we can learn about it. In the first place, what is the shape of it? It is **round, and flattened at the top and bottom**.

Take it in your hand, and see what else you can learn about it. It is covered with a **thin, smooth, shiny skin**, which easily cracks and peels off.

Let us cut it in two, and see what it is like inside.

Do so, and show that it is made up of layers, one under the other, with a sort of bud in the very centre.

We have learned all we can about this onion. Suppose we take another now. I want you to help me to find out which part of the plant the onion really is.

Look at the under side of it, and tell me what you see there. A bunch of little brown strings.

What do you think these strings really are? They look like roots.

Yes, **they are roots**. Here is a picture of the growing plant.

Point out the long stringy roots stretching down into the soil.

Tell that the onion itself is not the root. It is the lower part of the stem, and the real roots are these strings which stretch downwards from it.

As the onion plant grows this lower part of the stem swells out into a round ball. We call it a **bulb**.

Think for a moment of the turnip and carrot. You told me just now that they are thick, swollen roots, and that these roots swell up and become large, because they are storing up food to keep the plant alive while it cannot get its proper food from the soil.



The onion, like the carrot and turnip, would live on for a second season if it were left in the ground. It stores up food for itself, as they do, but not in the root. Its food-store is laid up in that **bulb** at the bottom of the stem.

III. THE CABBAGE

You all know what this is. It is a cabbage.

How does mother prepare a cabbage for the table? She cuts it open and boils it.

Suppose we cut this one open now, and see what we can learn about it.

Cut it in two, and show the children that it is made of leaves folded one over the other. Notice how closely the leaves are folded. The cabbage is like a **hard ball**, and yet it is made entirely of leaves. Let the children strip off the outer leaves one by one.

Notice the whiteness of the inside of the ball. Tell that the



leaves are white because the light cannot get to them in the middle of the ball. Explain that all leaves become white if they are shut away from the light.

So then, we know that when we eat cabbage we are eating the leaves of some plant. Let us see what kind of plant it is.

Show the picture of the growing plant, and lead the children to point out the parts of the plant—root, stem, and leaves—in turn. Tell that the cabbage itself is really a **great bud** at the top of the stem.

If a picture of growing Brussels sprouts could be shown it would be interesting and instructive at this point. Tell that this plant is a kind of cabbage, but instead of having one very large bud at the top of the stem, it has a great number of small ones. The stem grows about three feet high, and these little round buds grow out from it on all sides.



themselves that are eaten.

N.B.—We shall leave the other members of the cabbage family for the next stage. It will suffice for the present to show a picture of the cauliflower and broccoli, and to tell that they belong to this same family.

If time permit, a head of celery should be shown. This vegetable is white inside. It is made white by having the earth heaped up round it so that no light can get to it. Point out that it is the leaf-stalk of the celery plant, and not the leaves

IV. PEAS AND BEANS

Show next some pods of peas and beans. If the time of year permit, the green-pods should be provided. Let the children tell all they can about them.

Show pictures of the growing plants as before. In these plants we do not use either the root, the stem, the leaf-stalk, or the leaf. It is the seed-pod and its seeds which give us food.

Lead the children to tell that in the French bean variety we

cut up the green pods, and cook them just as they are; but we simply open the pods of peas and broad beans, and cook the seeds alone.

So, you see, we do not use the same parts of every plant for food. One plant gives us its **root**; another its **underground stem**; in another the stem is swollen out into a **ball or bulb**, to make the part which we want for food; another gives us its **leaves**; another its **leaf-stalks**, and another its **seed-pods**.

Lesson XXVI

FRUITS

A few apples, pears, and plums, a knife, and the picture of the growing peas and beans will be required.

I. INTRODUCTION

Show the picture of the growing peas and beans once more, and proceed as follows:—

Which part of these plants do we use for food? The **pods**.

What do we find in those pods? Seeds.

There are some pretty flowers on the plant as well as green pods. Are they of any use?

Lead the children to tell that the flowers always come first, and that when they die away, they leave the little green pods behind in their places. Point out some of the newly-formed pods in the picture, and explain that the pod is really the inner part of the flower.

The pod, then, is simply a sort of **box** or **case to hold the seeds**. We call it **the fruit of the plant**. These pods which you see in the picture are **the fruit of the pea and bean**, and you know that the actual pods are filled with seeds.

I want you to remember this, because when you think about fruit you do not usually mean things like these.

Suppose you tell me the names of some of the fruits you see in the shops. Apples, pears, cherries, plums, peaches, gooseberries, currants, strawberries, raspberries, blackberries, and grapes.

Assist where necessary, and make a list of them on the blackboard as they are given. Elicit from the class that these fruits are all general favourites because of their delicious flavour. Explain that they all grow on plants of some sort, just as the pea-pods grow—the flower comes first, and when that dies away, it leaves the fruit behind. Let us examine some of these fruits, and see what we can learn about them.

II. APPLES AND PEARS

Hand a few apples and pears round the class, and lead the children, in a step by step description, as follows :—

Let us take the apple first. What is the shape of it? It is something like a **round ball in shape**, except that it is flat at the top and bottom.

Now look at the pear. That, you see, is not round like a ball. It is big at one end, and pointed at the other. It has a shape of its own ; we say it is **pear-shaped**.

What do you see at the small end of the pear, and on the under side of the apple? **A short, thick, strong stalk.**

Lead the children themselves to explain that apples and pears grow on trees. They hang from the twigs by these stalks. Without strong, tough stalks they would be blown down by the wind. Picture the trees in blossom in the early spring. Tell that the blossoms grow on those stalks, and when they fade they leave the fruit behind. The fruit is at first only like a little green ball, very sour and very bitter, but as it grows it ripens, and becomes sweet and juicy.

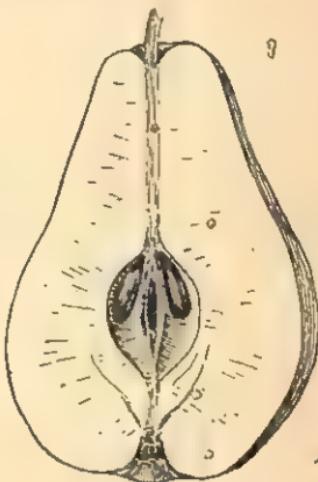
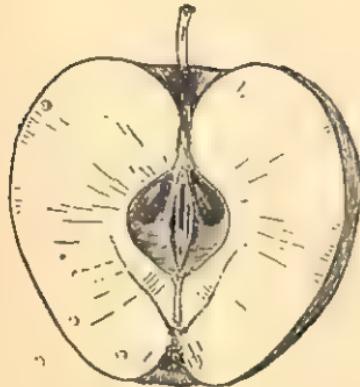
Let us now go a step farther. What do we call the outside of the apple and the pear? We call it the **rind or peel**.

Point out that the rind of the apple is usually smooth, and coloured—red, yellow, or striped; that of the pear is

coarser and rougher in appearance. In both it is **tough**, and **not good to eat**, although boys and girls often do eat it. All sensible people **peel their apples and pears**, and throw away the coarse, tough rind.

Now I think we have done with the outside. Suppose we cut one of them open, and see what the inside is like.

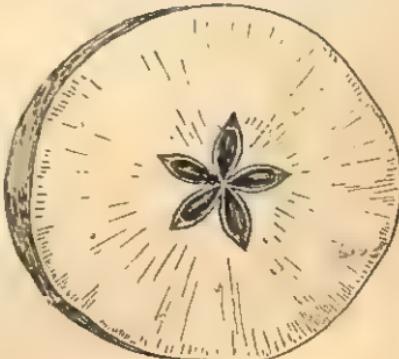
Cut open an apple and a pear, and show that in each of



them the inside consists of a **firm, whitish, juicy flesh**, with a sweet, pleasant taste and smell. This is the part of the fruit which we eat.

Point out the **core** in the centre. Cut it away, and show that it is a sort of **case or box**, made of some thin, stiff, tough substance. If the apple and the pear were cut across-wise, it might be advisable to point out the **five separate chambers** in the core.

Pick out the **brown pips** from them, and tell that these



are the **seeds**. They would grow into young apple-trees if we put them into the ground.

Now you can see why we call apples and pears **the fruit** of the tree. They are the **cases or boxes** in which the seeds grow.

III. STONE FRUITS^o

The fruits for illustrating this part of the lesson must necessarily depend upon the season of the year—a plate of cherries doing duty at one time, a few ripe plums at another. It is needless to say that the plum, from its larger size, would be preferable for the purpose. Let us suppose that the lesson is to be given at the latter part of the summer when plums are plentiful. Show a ripe plum. Call upon the children to say what it is, and then proceed to deal with it in much the same way as we did with the apple and the pear.

Notice first the **smooth, outside skin**. Show that it can be easily peeled off. Tell that when plums are eaten raw this skin should always be removed, as it is likely to make us ill.

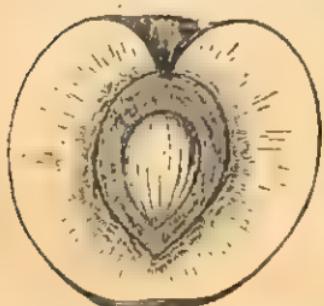
Show that the plum, like the apple and the pear, has a strong stalk. What is the use of the stalk? What grew on that stalk before the plum came?

Explain that the little plum, like the little apple, was at first a hard, green ball, and that as it grew in size and ripened, it became softer, and **full of rich, sweet juice**.

Cut the plum open, and point out that the inside of this fruit too is **firm and fleshy**, but it is much more juicy than the harder, drier flesh of the apple and the pear.

Notice the **hard, oval stone** in the centre, and tell that we call the plum **a stone fruit**. Remove the stone, and crack it, and show that it is simply a **hollow box**.

What is there inside this box? The **kernel**.



What is this kernel? It is the seed.

What would happen to it if it were put into the ground? It would grow into a young plum-tree.

The plum, then, with its soft, sweet, juicy flesh outside, and its hard, hollow stone in the centre, is simply a box to hold the seed.

Remember, this is what we always mean by the fruit of a plant.

Lead the children to name the different kinds of plums they see in the shops—e.g. the Orleans, the Victoria, the greengage, and the damson, or damascene plum. Assist of course where they fail. Show specimens if possible.

Call upon the class to name any other fruit they can think of, which has a hard stone with a kernel in the centre, and so lead them to tell that cherries, peaches, and apricots as well as plums are stone fruits.

Lesson XXVII

SOME MORE FRUITS

An apple and a plum, and specimens of as many as possible of the fruits named in the lesson should be provided; and there should also be in readiness pictures of each.

I. INTRODUCTION

COMMENCE by leading the children to talk about the fruits mentioned in the last lesson. Elicit that apples and pears, as well as plums and other stone fruits, are all solid and fleshy. We might call them fleshy fruits. Cut open some specimens of each with a knife, and let the children point out the difference between the rather dry, hard flesh of the apple, which can be easily cut into thin slices, and the softer, more juicy flesh of the plum. Show that it is an easy matter to press the juice out of a ripe plum by squeezing it in one's hand, but that it is not nearly so easy to do this with an apple, because the flesh is harder and drier.

II. SOFT FRUITS

In dealing with these (which include the strawberry, raspberry, mulberry, and blackberry) the teacher will once more have to be guided by the season of the year. Either of them will serve for illustration—the strawberry perhaps best of all.

The children should examine the actual fruit for themselves as far as possible; those that are not in season might be illustrated by means of pictures.

In every case a picture of the growing plant itself should be shown, so that the children may know how each particular kind of fruit grows—the mulberry **on a tall tree**, the raspberry and blackberry **on bushes**, and the strawberry **on a small plant**.

Lead them to tell, as they handle the fruit, that it is very much softer than the fruits of last lesson, although it feels solid, **almost fleshy to the touch**. Set one of the girls to squeeze the specimen up in her hand, and show how **very soft** and **pulpy** and **full of juice** it is. We call these the **soft fruits**.

Now, I want you to think for a moment, and tell me what we mean when we speak of the fruit of a plant. We mean **the case or box in which the seeds grow**.

What is the actual seed-box in an apple? **A hard, stiff core.**

What is the seed-box of the plum like? It is **a hollow stone**.

Where did we find the core and the stone? In the middle of the fruit.

But when you squeezed this soft fruit in your hand, did you find anything like a core or a stone? No.

See, I will cut this strawberry up into pieces! There are neither seed-box nor seeds inside it. But there must be seeds in these fruits as well as in others, for **all fruits are seed-vessels**. Where are the seeds?

It will interest the children to learn the arrangement of the seeds in these fruits. Point out that the raspberry, mulberry, and blackberry are, each of them, made up of a **great number of tiny fruits** massed close together. Each of these is a

little seed-vessel, and contains its own seed. Dissect one of the specimens, and let the children see the arrangement for themselves.

Show the strawberry, or a picture of one now. Point out that the seeds are embedded separately all over the outside of the soft, pulpy fruit, and not lodged in the middle of it, or in separate seed-vessels?

III. JUICY FRUITS

Currants, gooseberries, and grapes will be required to illustrate this part of the lesson, and as before the choice of the actual specimens will depend upon the season of the year.

Let the children examine the specimens as usual. Show and describe briefly pictures of the growing plants in each case. Lead the class to tell that these fruits, like the last, are **soft**, for they may be easily squeezed up in the hand.

Show, however, that they are less solid and fleshy than any of the fruits we have examined—they are not even pulpy. When we squeeze them we press out an almost liquid juice, and the seeds are like little loose pips in the midst of the juice. Take out the pips from some grapes, and let the children examine them. Show that the arrangement is the same in a gooseberry and a currant (black, white, or red).

We called these three—the grape, gooseberry, and currant—**juicy fruits** just now; but there is a better name for them than that. They are real **berries**. Each of those soft fruits—the strawberry, raspberry, mulberry, and blackberry, you notice, is called a berry of some sort; and yet it is a very bad name, for **they are not berries at all.**

A berry is a fruit like the grape or the currant. It has a thin skin filled with juice, and the pips or seeds are loosely placed in the midst of the juice. The gooseberry is a real berry; but strawberries, raspberries, mulberries, and blackberries are not berries in spite of their name.

IV. DRY FRUIT

Show a nut of some sort—a filbert, a hazel-nut, or an acorn for preference. Lead the children once more to tell the meaning of the name fruit; and then proceed to break open the nut, and show that this too is a sort of fruit. It is the box or case in which the seed grows. Show the seed or kernel in the middle of the hard case. Elicit that the acorn is the fruit of the oak-tree, and tell that all nuts grow on trees or bushes.

Lead the children to name all the nuts they know. Point out that walnuts, chestnuts, and almonds have a green-outside covering, but that this shrivels and dries up as the nut ripens.

Remind the children of the corn grains. Tell that the grain of corn is really a sort of dry fruit. It is the fruit of the corn-plant.

Lesson XXVIII

USES OF FRUIT

Provide a pot of jam, a stew-pan, and a piece of oiled paper.

I. INTRODUCTION

INTRODUCE with a short chat about the different kinds of fruit, so as to elicit from the children the substance of what has already been taught. Lead them to distinguish between the fleshy, pulpy, and juicy fruits—all different, yet all seed-vessels of some sort. Let them tell rapidly the nature of the seed-vessel in each case.

All these fruits except one grow on trees or bushes. Who can tell me which one I mean? The strawberry.

How does the strawberry grow? It grows on a small plant only a few inches high.

Which of the fruits grow on bushes? Currants, gooseberries, raspberries, and blackberries.

How would you know a gooseberry bush from a currant bush? The **gooseberry bush** is covered with **prickly spikes**.

What fruits grow on trees? Apples, pears, plums, cherries, and mulberries.

What do we call the tree on which grapes grow? A vine.

Remind the children that most fruits grow in orchards and gardens. The gardener takes care of the plants, and helps them to grow. We say he **cultivates** them. The blackberry, however, is never grown in gardens. It always **grows wild** on struggling prickly bushes in the hedge by the side of country lanes. It is a **wild fruit**. Picture children in the country gathering the ripe blackberries in the autumn.

Tell that in the same hedges we may often meet with **wild apples**. These are always small (about the size of a walnut), very sour, and very bitter—not fit to eat. We call them ~~crabs~~.

Be careful to point out that in all hedges there are many plants with **bright-looking berries**. Children should never pick and eat these, although they may look very tempting, for most of them are deadly poison.

II. RAW AND COOKED FRUIT

Which is the best time of the year for fruit? The summer time.

Why? Because that is the time when the fruit ripens.

What does that mean? It becomes sweet and nice to eat.

What makes the fruit ripe? The sun.

What is all fruit like before it ripens? It is green, and hard, and very sour.

How does the sun change it? It turns the sour juice of the fruit into sugar. It is the **sugar** in the fruit **that makes it sweet.**

In the summer, then, we get plenty of fruit. Some we eat raw just as it is picked; some must be cooked before it is eaten.

Carefully impress upon the children that none but ripe fruit should ever be eaten raw. Unripe fruit of any kind is very bad to eat. The sour juice would make us very ill. When it is cooked and sweetened with sugar, however, all fruit is very delicious.

Lead them to tell that mother gives them stewed fruit for dinner in the summer, and sometimes fruit puddings, pies, and tarts.

Can you tell me which is the earliest fruit in the year? Gooseberries come first, and then cherries and currants.

Quite right; but remember, although those green gooseberries may look very tempting to children, they must not be eaten raw. They are **only fit for cooking.**

Who can remember one kind of fruit which we always eat raw? The strawberry.

Yes; strawberries and mulberries too are best raw. We do not cook them; we eat them just as they are gathered. But raspberries and blackberries we eat both **raw** and **cooked.**

What would you do with a bunch of grapes? We should eat them **raw.**

Ripe grapes are very delicious, juicy fruits. **They are always eaten raw;** it would spoil them to cook them.

N.B.—*We are purposely ignoring raisins and currants here. They will come with more effect in the lessons of the next stage.*

Plums of all kinds are eaten **raw as well as cooked.** But remember they are the very worst of all fruit to eat in an unripe state. No kind of plum is fit to eat raw unless **the stone comes out of it quite clean** when it is opened.

Which, do you think, is the most useful of all' fruits? The apple.

Yes; the apple is certainly the most useful of all. It is longer in season than any others, too, and it can be kept for a very long time, for it is drier than most fruits. Some apples will keep till the new ones come on the trees the next season.

Call upon the class to enumerate the uses to which this fruit is put, assisting of course where they fail.

Apples are eaten raw as well as cooked; but only the ripe fruit should be eaten raw, and the peel should be removed, for that is hard and tough and not fit to eat.

Lead the children to tell of apple pies, puddings, and dumplings. Baked apples, too, are considered a great treat.

Pears are a useful and delicious fruit. They are mostly eaten raw, although some people are very fond of baked and stewed pears.

III. PRESERVED FRUIT

Remind the children once more that the summer is the time for fruit. It grows and ripens then, but as most of it is soft and juicy, it will not keep very long. It would soon rot and go bad, and unsound fruit is very dangerous to eat. When winter comes there is no more fruit. Every one, and especially children, are so fond of fruit that it is hard to do without it. Tell that it was because of this that people at last hit upon a plan by which they could have fruit all the year round.

What does mother give you as a treat sometimes on your bread? Jam. Do you know what this jam is? I will tell you. It is fruit which has been boiled in sugar. Only the best, sound, ripe fruit and the best loaf-sugar should be used for jam. It is boiled in a copper stew-pan, and carefully stirred all the time: and when it has been boiled long enough it is put into jars, and closed down with oiled paper, to keep the air from getting to it. It will then keep for a very long time, and is ready to be

made into jam tarts and puddings while there is no fresh ripe fruit to be got.

It would be advisable to show an actual stew-pan, a pot of jam, and a piece of oiled paper, if these things could be obtained.

IV. FRUIT FOR WINE

Before leaving the subject, it might be well to notice that fruit of all kinds is used for making wine. Most wine is made from grapes, but currants, gooseberries, and other fruits are also used for this purpose. Apples are made into a drink called cider; the juice of the pear makes another drink called perry.

Lesson XXIX

A POT OF HONEY

Provide some honey, a specimen of honey-comb, a few fresh gathered flowers, a large well-developed flower of some sort for dissection; a living bee under an inverted tumbler if possible, or failing that a picture of the insect, a picture of the bee-hive.

I. WHAT IT IS

Show the specimen of honey, and lead the children to examine and describe it. Their eyes will tell them that it is a thick kind of liquid, of a bright, golden-yellow colour. If they smell it, they will find that it has a sweet, delicious smell; and if they put some of it into their mouths, they will learn that it tastes sweet—very much sweeter than sugar. It is a rich, sweet juice or syrup.

Tell that this delicious honey comes from the flowers. In most flowers there is, at the very bottom of the flower-cup, a tiny drop of sweet juice, which we call nectar.

If possible, have a few fresh gathered flowers for the lesson. Hand some of these round the class for the children to suck, so that they may discover for themselves the sweet nectar in them.

This will rouse their curiosity to learn how the honey is actually obtained.

II. THE BEE AND ITS HABITS

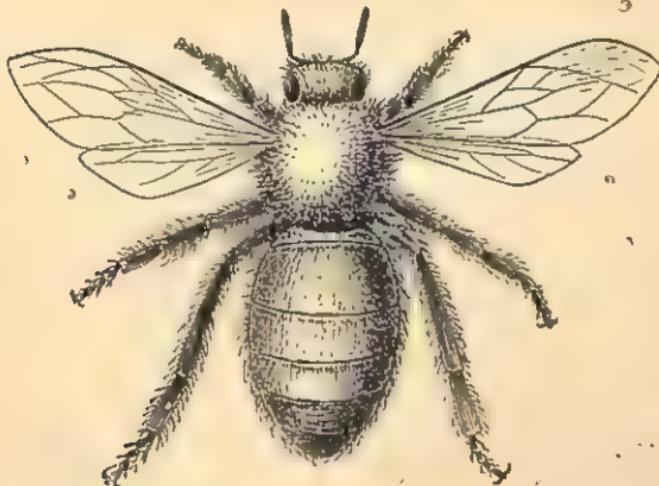
The honey, then, comes from the flowers, but remember we could never get it ourselves. This is the clever little thing which gathers all the honey.

Show, if possible, a living bee under a glass.

Do you know what it is? It is a bee.

Look at it and tell me what it is like. It is something like a very large fly.

Show a picture of the bee, and lead the children to point out



the peculiar form of the body. It is made up of three parts—first the head, then the chest, and then a big part behind the chest. Point out that these three parts are almost separated from one another. The body looks as if it were cut through in two places. In this way lead up to the name in-sect.

Point out the two pairs of delicate, gauzy wings. Flies have only one pair of wings. Notice too the six legs, three on each side. Tell that all insects have six legs. Call

attention to the fine hairs which cover the whole of the body and legs.

I daresay some of you have seen the bees flying about in the fields and gardens in the summer time. Have you ever noticed where they go, and what they do? They keep flying about from one flower to another.

Lead the children to describe, as far as they can, the visits of the bee to the flowers. Picture it alighting on a flower and forcing its way into the very bottom of the flower-cup. After a time it comes out again, and flies away to some other flower to do the same. Why does it visit the flowers in this way?



This clever little insect is searching for honey; that is why it pushes its way right into the middle of the flower. It knows, too, that **there is no sweet nectar in some flowers**, and it never pays them a visit. Whenever it alights upon a flower, and pushes its way in, it is busy all the time **sucking up the sweet juice**, and it goes from flower to flower till it has got as much as it wants.

Tell that the bees do not eat this sweet syrup themselves. They only suck it up into a little bag in their bodies, and carry it away to their homes. When they get there they give it all up, and it is stored away, to serve as food for them in the winter when all the flowers are gone.

Show next a well-developed flower of some kind. Call attention to the **anthers** inside. Let the children touch them, and point out the **yellow dust**, which adheres to the finger when they take it away. This is the pollen of the flowers.

Tell that the bees collect this pollen also from the flowers, and carry it home. They use it to feed their young ones. It has been called bee-bread.

Remind the children that we never see bees flying about in the winter time. Explain that there are no flowers then, and the bees remain snug and warm in their homes, till the cold weather has all gone.

III. THE BEE-HIVE AND THE COMB

We have spoken several times of the bees' home. Perhaps you would like to know what kind of a place it is.

Show a picture of a bee-hive, or draw a sketch of one on the blackboard.

People who keep bees give them a little house like this to live in. It is called a **bee-hive**. A number of bee-



hives, are stood in a row on some benches in the garden near the flowers. In each little house immense numbers of bees live together. There is a little hole near the bottom of the hive which serves as a door for the bees to go in and out.

Show now a specimen of the honey-comb. Tell that, as soon as the bees get settled in their hive, they commence to build row after row of little boxes like these. We call the wall of little boxes the honey-comb. They always build their boxes the same shape, with six sides. They build them with wax

(bees'-wax), which they make for themselves from the food which they have eaten. Show a specimen of bees'-wax.

Call attention once more to the honey-comb. Open one of the cells, and show the honey inside. Tell that these clever little insects make their honey, and store it away in these boxes or cells, just as mother makes jam, and stores it away in jam-pots for use in the winter, when she cannot get any fresh fruit.

People who keep bees want the honey for themselves, so when the bees have filled their cells their masters take away as much as they want, and leave them only just enough to keep them till the winter is over.

Lesson XXX

A GLASS OF WATER

Articles required : some moist sugar, a slice of bread, a fresh potato and a dry, withered specimen, one or two common vegetables, two saucers, a jug of water, a basin, a bottle, a tumbler, a toasting-fork, and a knife.

I. INTRODUCTION

We have talked about the articles, one by one, which we see on the table at meal-time, but we have not yet said anything about the most important of all of them. The article I mean is so important that it is on the table at every meal. Can you tell me what it is ? It is water. Here is a glass of water. Let us see what we can learn about it.

II. WATER A LIQUID

1. It flows about. — Stand two saucers on the table. Fill one to the brim with moist sugar, the other with water, and proceed as follows :—

Both saucers, you see, are full, but I will try whether I cannot put a little more sugar in this one. See, I can

go on piling up the sugar in a great heap above the edge of the saucer, and it stands there. Now, let us do the same with the water.

Pour some more water into the other saucer, and call upon the children to notice and describe what takes place. The water will not stand in a heap as the sugar does. It keeps a level surface, and as soon as the saucer is full it flows or runs away over the edge, and spreads itself over the table.

2. Water takes the shape of the vessel which holds it.—Call attention once more to the saucer of water on the table. Notice that the water fills the saucer quite up to the brim.

What is the shape of the saucer? Round or circular.

Then what must be the shape of the water? The water is round too.

Now carefully pour the water out of the saucer into a number of other vessels, one by one, and lead the class to see that in each case the water fills up every part of the vessel, and therefore **takes the shape of it**. Show, too, that in each case the water always keeps a level surface. It cannot stand in a heap; it cannot slant.

Explain that we call all bodies which act like this liquids. Liquids cannot stand in a heap; they cannot slant, but always keep a level surface; they take the shape of the vessel which holds them, and when we pour them out of the vessel they flow or spread about.

III. WATER IN ALL OUR FOOD

Lead the children to tell that the tea, coffee, cocoa, and milk which they see on the breakfast table are all liquids like water. The tea, coffee, and cocoa are made with water, and milk contains a very large quantity of water.

I told you just now that water is the most important of all the articles we see on the table at meal-time. Let us find out why this is so.

In the first place, it is easy to see that water forms the

chief part of all the things we drink. Whatever the drink is it is made with water. We may call the things which we drink **liquid foods**.

But if all these liquid foods were taken away there would still be plenty of water on the table. How is this?

Hold a slice of bread in front of the fire on the toasting-fork, and call upon the children to notice the steam which rises from it as it gets hot.

What does steam always come from? It comes from water when we boil it.

Yes; you, of course, have seen steam coming out of the spout of the kettle. The heat of the fire changes the water in the kettle into steam. But this steam is **coming out of the bread**. What must there be in the bread then to make the steam? Water.

Remind them that in making bread, cakes, biscuits, pies, and puddings of all sorts, water must be mixed with the flour. Some of this water goes off in steam while the bread is baking, the rest is left behind. It is in the bread although we cannot see it. There is some water even in the driest-looking bread.

Cut open a potato, and show how moist it is inside. Place one on the fire-shovel over the fire, and let the children see the steam rising from it. Show another which has been thoroughly dried, and let them notice how light it is. It has lost all its water.

Do the same with one or two other common vegetables, and proceed thus:—

All these vegetables, you see, contain water; but what are they, and where do they come from? They are parts of different plants.

How did the plants get the water? They sucked it up from the soil with their roots while they were growing.

Quite right; and you must remember that **every part of every plant** contains water. If we cut, or bruise, or squeeze any part of a living plant some watery liquid will be sure to ooze out. What do we call this watery liquid? We call it **the sap**.

Tell that not only vegetables and fruit, but even **the dry-looking flour**, which is made from the grains of corn, contains water, and this water was all sucked up from the soil by the plants when they were alive.

How did the soil get its water to give to the plants? The water fell from the clouds in **drops of rain**.

What would happen to the plants if there were no rain? They would all die.

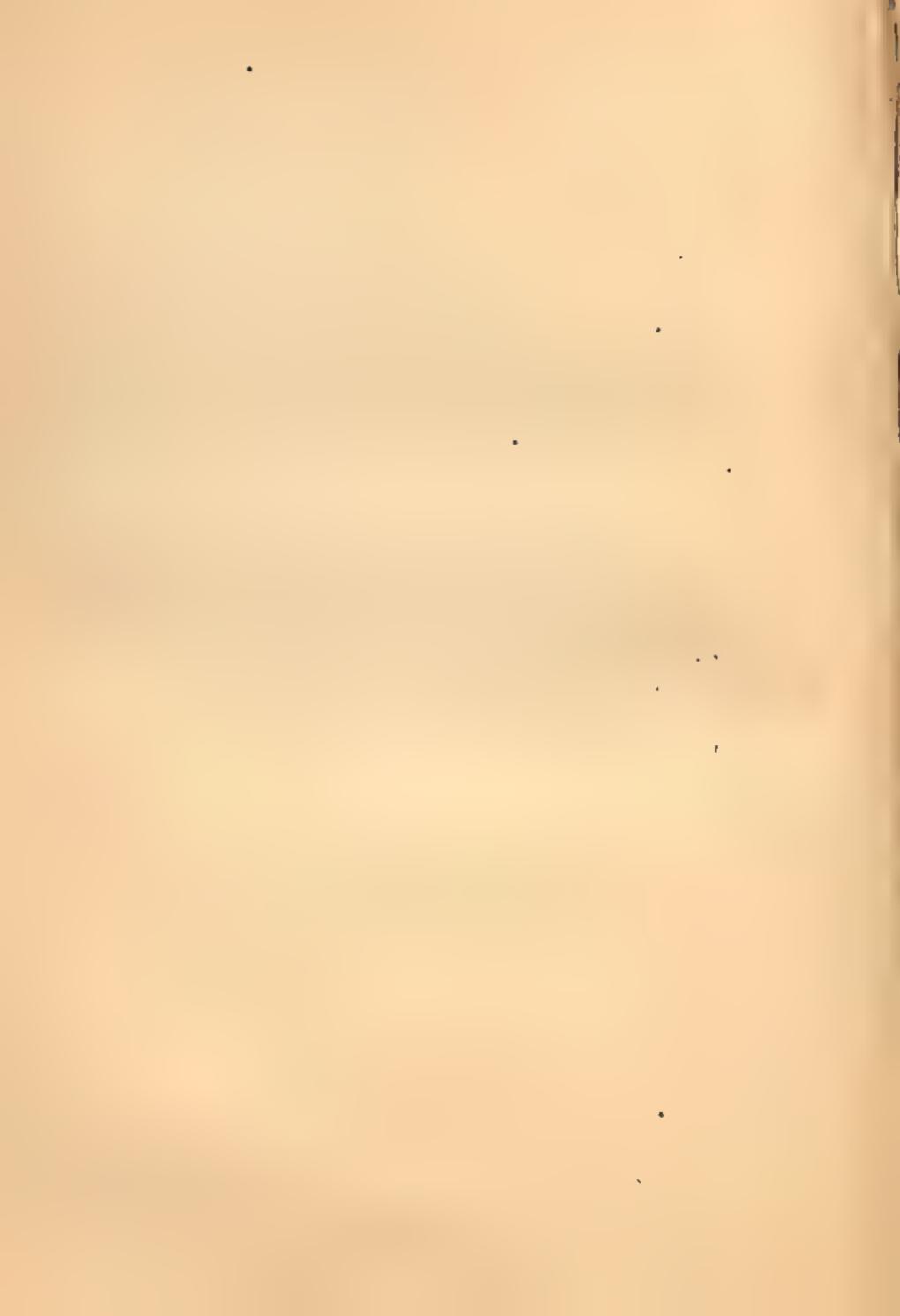
So you see that not only is there water in every kind of vegetable food we eat, but that without water **the plants themselves**, which give us this food, **would die**.

Hold a piece of raw meat in front of the fire. Call attention to the steam which rises from it, and then point out that in animal food as well as in vegetable food there is always a large quantity of water.

There is water in all our solid food as well as in our liquid food. That is why we say that water is so very important. There is sure to be water on the table at every meal, whether we can see it or not.



STANDARD II



STANDARD II

Lesson I

A LOAF OF BREAD

Provide for illustration a loaf of bread, a dumpling, a jug of water, a saucer, a dry sponge, and a picture of the bakehouse.

I. INTRODUCTION

Show the loaf, and commence by calling upon the children to tell all they can about it. Lead them to describe its general appearance and properties as a whole; then let them tell the materials of which it is made; and lastly, give in their own simple way some account of the work of bread-making. This will elicit the extent of their knowledge, from the teaching in the previous stage, after which the lesson may proceed in some such way as follows:—

II. BREAD IS POROUS AND ABSORBENT

Look at this dumpling. Can you tell me what it is like inside? It is **hard, tough, and close**.

What do we say about it? We say it is **heavy**.

What is the loaf like inside? It is **soft and full of holes**.

How do we speak of bread because it is full of holes? We say the bread is **light and spongy**.

What do we mean by saying the bread is spongy? We mean that it is **full of holes, like a sponge**.

Quite right. Now I think you may learn a new word. Those little holes in the sponge and in the bread are called **pores**. We say that the sponge and the bread are **porous**, because they are full of holes. **Porous** means **full of holes**.

Put a little water into a saucer, and place in it a piece of the crumb of the loaf. At the same time stand a dry sponge in a similar saucer of water. After calling upon the children to notice what has been done, let one of them come out and take away the sponge, and then turn the saucer up, and show that it is empty.

There is no water in the saucer now. What has become of it? It is in the sponge.

Prov. that it is in the sponge by squeezing it out into the saucer again.

The sponge, you know, is full of little holes, or **pores**. We say it is **porous**. It sucks up the water because it is porous; the water fills up the little holes in it. Now let us look at the piece of bread.

Show that exactly the same thing has taken place in the bread. The water has left the saucer and is now in the bread.

Bread is porous, like sponges.

The sponge and the bread suck up the water, and it fills their pores.

Now I want you to remember a long word which means the same as the words **suck up**.

The word is **absorb**. All things that are porous, like sponge and bread, **absorb**, or **suck up** water through their pores. We say they are **absorbent**.

Which of the materials makes the bread porous and absorbent? The yeast. **Bread made without yeast would be close like the dumpling.**

Picture the children with their basin of bread and milk at breakfast time. The porous bread absorbs the milk into its pores till it is soaked through; but the dumpling would not do this. It is not porous.

III. USEFULNESS OF BREAD

Lead the children next to think of the great usefulness of bread as an article of our daily food.

We see it on the table more often than any other kind of food. Indeed it forms part of every meal in the day for father, mother, and children.

We eat it with butter or dripping, treacle, jam or marmalade at our lighter meals, and we also eat it with fish, meat, and vegetables at dinner. But any one who is really hungry will devour bread eagerly without anything else, and enjoy it.

It is one of the first things baby has, as soon as it is strong enough to take a little solid food with its milk; and very old people can always eat and enjoy bread when they cannot take other food.

Bread is often called the "**Staff of Life,**" because it can, by itself, support us and keep us alive. No other food would do this so well as bread. It is the most important of all our food.

IV. HOW BREAD IS MADE

Explain to the children that the work of bread-making, as they described it at the beginning of the lesson, is very simple. It is just the way mother would set about making a loaf at home. Most of our bread is made by the baker in a great bakehouse. He uses sacks of flour at a time, and makes it all up into loaves. Let us watch him at work.

1. Setting the sponge.—He takes a certain quantity of flour,—say half a pound,—and mixes it into a thin paste with about three pints of warm water, and about four table-spoonfuls of yeast. This he sets aside in a warm place for six or eight hours.

I think you will be able to tell me what happens to the yeast during this time?

The warmth would make it work. It would foam and froth and puff up.

Exactly ; that is just what does take place. The baker calls this **setting the sponge** ; and he usually does it the night before he wants to make the bread.

Some bakers boil and mash potatoes, and mix them with the sponge to help to make the bread light.

2. Kneading the dough.—When the sponge has stood long enough, and is quite ready, he prepares to



make the bread. But let us first of all have a look at the **bak-house** and see what that is like.

Show a picture of the bakehouse. Call attention to the great **bins** or **chests** along the side of the wall. When mother makes her loaf of bread at home, she mixes it in a basin ; but remember, the baker in his bakehouse has to mix enough flour to make perhaps a hundred loaves at once. He must have a very big basin.

This great wooden bin is his basin. He calls it the **kneading trough**. Picture him there with his arms bared above the elbows, filling the trough with the white flour.

This done, he takes the **sponge** and mixes it with more warm water, and then making a big hole in the

middle of the flour with his hands, he pours in the mixture. Then he begins to move and turn it all about, and punch it with his hands, till the yeast is well mixed into every part of the flour.

Explain that he calls this kneading the dough. That is why the great bin is known as the kneading trough. It is hard work to knead, and punch, and work up the dough in this way.

When it has been sufficiently kneaded, the dough is left for several hours to rise; and then it is kneaded again, and once more left to rise.

After that nothing more has to be done but to cut the dough in lumps and weigh them, and then the lumps are made up into the proper shape for loaves, and put into the oven to bake.

Call attention once more to the picture and point out the great oven. It looks like a hole in the wall with an iron door or shutter. It is big enough to take all the loaves at once. The baker calls them a batch of bread.

Point out and describe the long peel with which the loaves are put into the oven, and drawn out again when they are baked. Explain the reason for its use. The baker talks of drawing the batch when he takes the fully-baked loaves out of the oven.

Lesson II

FLOUR

Specimens of wheaten flour—whole-meal, fine white, house-holds; some common laundry starch, macaroni, salt, a jug of water, a tumbler, a spoon; a saucer, a piece of muslin or cambric, a basin, and a knife will be required.

I. INTRODUCTION

PRODUCE the specimens of wheaten flour, and commence as usual by reminding the children of their earlier lessons, and so

lead them to tell all they can of the materials before them. By examining all three they will have no difficulty in distinguishing the **whole-meal**, the **fine whites**, and the **households**.

Lead them to tell that all three come from the grains of wheat, and that the wheat when first ground makes a coarse, brown meal—**whole-meal**—like this in the saucer. What makes the meal brown and coarse? What name do we give to these little pieces of the skin? How does the miller get his fine white flour from this brown meal? What is the difference between the **households** and the other two? In some such way as this the path may be prepared for what is to follow.

II. STARCH AND GLUTEN

We are now going to learn something more about flour; but I want you first to watch me.

Show a few pieces of common laundry starch.

You know what this is, of course? It is **starch**.

Yes, it is starch, and you know your mother uses it to stiffen the shirts and collars. She mixes the starch into a thin paste with water in this way.

Mix a little of the starch in a tumbler, stir it up well so that all can see, and stand it on one side for the present.

Next show some powdered salt in a saucer.

I have something else here. If you dip your finger into the saucer and put it to your tongue, you will tell me at once what it is. It is salt. See, I will put the salt into another tumbler of water and stir it up as I did the starch.

Come and show me the salt in the water, Mary. **I cannot see the salt now.**

No, you cannot see the salt, but it is there. Dip your finger into the water and you will find that it tastes salt. Now tell me what all this means.

Lead the children, in this way, to tell that the water has broken the salt up into such tiny particles that we cannot see them—that the smallest drop of the water contains some

of the salt—that we could not pour out the water and leave the salt behind. We say the water **dissolves** the salt.

- Can you think of anything else that dissolves in this way? **Sugar dissolves** when we put it into our tea. It makes the tea sweet, but we **cannot see it in the cup.**

Quite right. Now let us look once more at the starch in the other tumbler.

Point out that the starch has all sunk down, and lies at the bottom of the glass: stir it again, and show that it will not disappear as the salt did. It makes the water look thick like milk; we can see it in the water, but we could not see the salt.

Let it stand for a short time, and show that the water again becomes clear, because all the starch sinks to the bottom. It will not dissolve. We could pour the water away now and leave all the starch behind in the glass.

Now let us set this starch aside and turn to something else.

Take a little of the wheaten flour from one of the saucers (the household will be best for this purpose), mix it into a paste with water, and tie it up in a piece of muslin or cambric. Hold it in a basin of water, and knead it between the fingers and thumb, calling upon the children to tell what they observe.

The water at once begins to show a white, milky appearance, and the longer the bag of paste is squeezed the whiter the water becomes.

Pour the water out of the basin into a tumbler, and after letting the children examine it, stand it aside for awhile.

Next take the bag and open it. Call attention to the white, sticky matter left inside. Let the children examine it for themselves, and they will find that it is almost as sticky as glue. It sticks to their fingers when they touch it.



By this time the tumbler may be examined again. Turn to it and point out that the water in it is now quite clear.

What has become of the white stuff that came out of the flour and made the water look like milk? Has it dissolved? Let us see.

Show that it has not dissolved, that it lies at the bottom of the glass.

We could pour off the water now and leave this white stuff all beⁿind.

Stir it up with a spoon, and show that the water at once becomes as milky-looking as before. This white stuff, whatever it is, will not dissolve.

Now, you see, we have got two very different things out of the flour by squeezing it in the water. In the bag we have that **thick, sticky stuff**, and here in the water we have a **white substance which will not dissolve**, but makes the water look like milk. We are going to find out what these two things are. Let us begin with this stuff which has made the water milky-looking. You have seen something like this before, I think. What does it look like? **It looks just like the starch** in the other tumbler.

Explain that this substance is really starch—that flour contains a large amount of starch—and that starch is a very important kind of food.

Explain, too, that if the water were poured away, and the white stuff at the bottom of the tumbler dried over a gentle heat, we should get real starch.

Show some which has been prepared previously in this way, and let the children examine it and compare it with the pieces of laundry starch.

So then, one of the things we have got from flour is **starch**. Now let us turn to the other stuff left behind in the muslin bag. We call it **gluten**, and I want you to remember that this is the best part of the flour, for it **helps to make our flesh and bones and blood**. Flour without any gluten in it would not make good bread; it would not make girls and boys grow big and strong.

III. FLOUR FOR BREAD, PIES, AND PUDDINGS

Mix a little flour with water into dough, and show that this dough may be kneaded, and rolled, and cut, and made up into any shape we please. Picture the baker at work in the bakehouse. He **kneads his dough**, and works it up into loaves of many different shapes, and when they are put into the oven they **keep the shape** which he has given them. We say the dough is **plastic**.

Now mix up a similar quantity of pure starch into a paste, and show that it is very difficult to make this paste hold together. If a loaf were made with it, it would **fall to pieces**—it would not hold together.

Why does the dough hold together? It is the **sticky gluten** in the flour that holds the dough together and makes it **plastic**. There is no gluten in this starch. That is why it would not make up into a loaf—it would **crumble to pieces**.

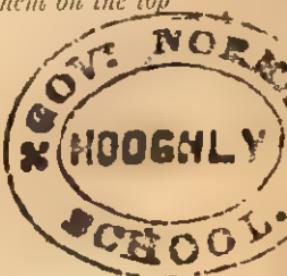
Show a few sticks of **macaroni**. Tell of its use in making soups and puddings. Explain that it is prepared from wheaten flour by first getting rid of most of its starch. The **plastic gluten** which is left is then rolled up into these hollow sticks and dried.

Picture mother at home making a pie. She **rolls out her plastic dough** with the rolling-pin, and when she has made her pie she marks the edge of it with a fork or a spoon, and perhaps cuts out a dough leaf or two, and places them on the top to make it look nice.

Lesson III

CORN

The teacher will require some grains of wheat, barley, and oats, and some corn-grains growing in a saucer as described in the lesson.



I. INTRODUCTION

Show the specimens of wheat, barley, and oats in separate saucers, and proceed to introduce the new lesson in some such way as this :—

We have one name for all these. What do we call them? We call them grains of corn..

What is the proper name for the grains in this saucer? Wheats.

What do we call these? Barley.

And these? Oats.

Lead the children themselves to point out the difference in the appearance of the three grains—the wheat short, round, plump, and smooth; the barley paler in colour and longer, and covered with a hard, rough skin; the oats longer and thinner than either of the others, and covered with a smooth husk, which is sometimes a pale yellow, sometimes black.

What becomes of these grains if we put them into the ground? They grow.

What name do we give to things which grow when they are put into the ground? We call them seeds.

These corn-grains then are the seeds of the corn-plants.

II. NATURE OF THE GRAIN

1. The germ.—We will now proceed to examine the grains a little more closely. We will still keep to the wheat, as they will show us what we want to see better than the other grains. But before we examine the grains themselves, I want you to look carefully at this drawing on the blackboard.

Sketch an enlarged drawing of a grain of wheat, and call upon the children to tell all they know about it. They will have no difficulty in telling that the large rounded end is the bottom of the grain, and that the little oval spot near this end marks the place where the grain was joined to the central stalk of the ear at the bottom of the husk or shell.

Now hand the grains of wheat round, and let them find these parts for themselves. The little oval mark looks something like a scar.

I daresay you remember that, when the corn-grains were put into the earth in the flower-pot, tiny roots shot downwards, and a little green blade forced its way upwards from each of them. They would all have grown into big, corn plants if left to themselves; and in every one of them **the root and the blade both came from this little oval scar** at the bottom end of the grain.

Now let me give you a surprise. Just underneath that little scar in each of these grains is a **tiny corn-plant waiting to grow**. This tiny plant cannot grow while the grain is kept dry; if we want it to grow we must put it in a warm, moist place. It was the warmth and moisture that made those grains grow in the earth of the flower-pot.

Have in readiness some sprouting grains of wheat in different stages of growth. These should be prepared beforehand as follows:—Spread a piece of flannel in a shallow plate or saucer, and, after soaking the grains for an hour or two, sprinkle them on it. If the plate be stood in a moderately warm room, with enough water in the bottom to keep the flannel wet, the grains will soon begin to sprout. It would be necessary for our present purpose to put the grains in at different times—to have different sowings, so to speak.

Produce the saucer, and call attention to the young plants growing up from the flannel.

The little plants have begun to grow, you see. Here is one,—a very tiny thing, only just sending out a few shoots. This one is older—it has a root and a stem. But still they are all growing.

Now think of baby at home. You can see him grow, and get stronger and stronger from week to week. But what makes him grow? Mother feeds him with milk till he is big and strong enough to eat other food. **These baby plants must be fed too**, or they cannot grow. Before the tiny thing in the grain can make

its first start in growing it must have some food, and that must be the right sort of food. How does it get that food?

Explain that these grains have been growing on the flannel, with nothing near them but clear water. They could not feed on the flannel, and there is nothing in the water to feed them.

2. Food for the baby plant.—These tiny germs in the seeds are too small and too weak to find food for themselves. When they grow into real plants with roots they will be able to get all the food they want out of the soil in which they live; but at first they have no roots; they could not get food out of the soil. Let me tell you where they find their food. The germ itself, as you know, takes up a very small part of the grain; it is quite covered by that little oval scar. All the rest of the grain is nothing but a **store of food, laid up for the tiny baby plant to feed upon**, till it has grown big enough and strong enough to seek its own food.

This shows you how it is that the germs in these grains grew on the flannel with nothing but water near them. They were feeding all the time on the food-store laid up in the grain itself. The water moistened the food, so that the tiny things could suck it in; that is all.

III. THE FOOD-STORE IN THE GRAIN

Cut open a few grains of wheat, and hand them round the class for examination. Lead the children themselves to tell what they observe. The whole of the middle of the grain is white—the outside part is of a yellowish brown colour.

Think now for a moment about our last lesson. What are the two substances we got out of the flour by washing it in the muslin bag? We got **starch** and **gluten**.

Quite right; and now you will easily remember that the white, crumbly substance in the middle of the grain is **starch**, and the hard brownish substance all round it is

gluten. The gluten always lies just under the skin of the grain.

In conclusion lead the children to think about the different qualities of flour which the miller gets by sifting the meal. The **pollard** and **bran** are pieces of the **outside skin** of the grain. When they are sifted out from the flour they take with them a great part of the gluten.

Lead them in this way to see that the whole-meal flour must make the best bread, because it contains the gluten as well as the starch. The finest white flour, which the baker calls "best flour," is nearly all starch—it contains very little gluten. It cannot be so good for food as either the households or the whole-meal.

Lesson IV

THE CORN-PLANTS

Articles for illustration: the growing corn-plants from the previous lesson, some ears of wheat, barley, and oats, a cobb of maize, and a few of the loose grains, some rice, and pictures of all the growing plants.

I. INTRODUCTION

COMMENCE by reminding the children of the grains of corn which we examined in the last lesson. Produce them once more, and proceed as follows:—

Where did these corn-grains all come from? They grew in ears on the corn-plants.

What can you tell me about the plants themselves? They are all grasses; we sometimes call them **corn-grasses**.

What do you remember about these grass-plants? They are all alike, for they all have **hollow stalks**, and **long, narrow, pointed leaves**.

What else can you tell me about their stalks? They are **round** as well as hollow, and they have several **knots** or **joints** in them.

What is the use of these joints in the stalk? They make the hollow stalk **stronger** than it would be.

Now, think of the leaves. What do you remember about them? They all **spring from the joints** in the stalk.

What name do we give to leaves of this kind? We call them **blades of grass**.

If you hold one of them up to the light what do you notice? The **veins in it run side by side** in straight lines from one end to the other.

Where should we find the ears on the growing corn-plant? The ears grow at the very **top of the stalk**.

Now, if you think about those long leaves, you will be able to tell me why they are very useful to the ears. The last leaf always folds itself round the topmost point of the stalk. It **takes care of the tender ear** till it is strong enough to bear the sun, wind, and rain.

II. THE EARS

Show ears of wheat, barley, and oats. The children will have become familiar with them from their earlier lessons, and should be easily able to distinguish one from the other.

You can easily pick out these different ears, but it is not so easy to tell the three kinds of

corn from one another, when we see them growing in the fields, especially when they are young and green. They all have the same hollow, jointed stalks, and the same long, narrow, pointed leaves. **Wheat, however, grows taller**



than either of the others, and so after a time it becomes easier to tell. But there is no difficulty in telling any of them as soon as the ears begin to show.

We will examine these ears a little more closely now.

Produce once more the ear of wheat. Strip the grains and their husks one by one from it carefully, so that all may see. Point out that the grains are arranged round the central stalk.

Let the children examine this part of the stalk for themselves. Lead them to find out that it is not straight, hollow, and rounded like the other part lower down; it seems to have been pressed and flattened in some way.

Explain that the little hollows which can be seen along this central stalk mark the places where the wheat grains grew, and as the grains swelled up and became bigger they pressed the hollow stem out of its first shape to make room for themselves.

Next take the ear of barley, and deal with that in precisely the same way by first stripping off the grains one by one, and then examining the central stalk.

Point out that in this ear the grains are arranged not all round the central stalk, but in two rows, one on either side of it.

Now, what else can you tell me about the ear of barley? The barley is bearded and the wheat has no beard.

Wait, and we will see. The wheat which we have been examining certainly has no beard, but I have here another ear of wheat, and this, you can see, has a beard like that of the barley.

Strip off the grains one by one from this ear as before, and show that it is really wheat and not barley. Let the



children themselves point out the difference both as regards the grains and the central stalk in each case.

Explain that most of the wheat we see is sown in the autumn. Lead the children to tell that, as this has to stand the winter, it must be very hardy. The bearded wheat is a more tender and delicate plant; it is sown in the spring, and is always known as spring-wheat. The beard is meant as a protection to the growing grain. The hardy autumn-sown wheat has no need of a beard to protect it. It never has a beard.

Turn next to the ear of oats. Notice the difference between this and the other ears. Each grain hangs loose at the end of a thin slender stalk of its own.

Refer the children to their earlier teaching, and lead them to tell the purpose of the husk. It forms a sort of thatch to keep the grain dry. This grain grows in damper, colder regions than either wheat or barley.

There is another kind of corn-grass grown in this country. It is called rye, but we never use the ripened grain. We cut it while it is green, and use it for feeding cattle.

III. OTHER CORN

1. Maize.—I have now another ear of corn to show you.

Produce the cobb and some of the loose grains in a saucer. Tell the name. Let the children compare this ear with the ears of wheat, barley, and oats. Notice how closely the grains are set side by side in the cobb.

This kind of corn does not grow in our country. It would never ripen its grain in such a cold land as ours. It grows in the warm countries of the world.

Show a picture of the plant. Explain that, like all the other corn-plants, it is a kind of grass, although it looks much bigger and stronger.

Let the children take the cobb in their hands, and lead them

to tell that a big, heavy ear like this must require a stout, strong stem to support it.

- This plant grows from 6 to 10 feet high, and its stem, although it is hollow and jointed, is as big as a child's wrist.

Call attention again to the picture, and point out the long leaves springing from the joints in the stem. Explain that they are exactly the same sort of leaves as we found in the other corn-grasses, and, like them, they fold themselves round the growing ear to protect it.

2. Rice.—*Lastly, show some grains of rice, and call upon the children to tell what they are. Explain that rice is another kind of corn. It would not grow here; it grows only in very hot lands.*

Show a picture of the plant, and lead the children to notice for themselves the same characteristics as they have before observed in the other plants. This plant, like the rest, is a sort of grass. It has tall, jointed stalks, and long, narrow, pointed leaves or blades springing from the joints.

Explain that the grain grows in an ear, and each grain as it grows is covered with a brown husk. The husk is all removed before the grain is sent to us.

Lesson V •

THE CORN-FIELDS OF OTHER LANDS

Hare in readiness for illustration the cobb of maize, some loose grains, and some rice, and pictures of the growing plants.

I. INTRODUCTION

INTRODUCE the lesson with a short chat about the corn-field—its appearance in the spring, its appearance in the autumn when the grain is ripe. Lead the children to tell all they remember from their earlier lessons of the work of cultivating and harvesting the corn, the teacher, of course, coming to their assistance where they fail.

Too much detail should not be required in the various operations. The whole should be dealt with in a very simple way, the object being merely to refresh the children's memory and preserve the continuity of the teaching. The only points that need be touched upon are —the purpose of the plough in turning up the soil, the advantage of that implement over the spade, the harrow and its work as illustrated by the garden rake, the mode of drilling the seed in rows a few inches apart, the object of rolling the ground after sowing, and the way in which the ripened plants are mown down and stacked in sheaves at harvest-time.

II. MAIZE

Let us next have a chat about some of the corn-fields of other lands.

Show the cobb of maize ^{to}, some of the loose grains, and let the children tell what they see.

Yes, this is an ear of corn, but it is a **very large and heavy one**. What do you remember about the plant on which it grew?

In this way lead the children to tell what they already know of the plant, with its **thick, stout stem** often rising to a height of **10 feet**. Measure 10 feet on the wall.

It would be well now to show an actual plant. This may be easily done by timing the lesson. The grain, if soaked in water, will readily spring up and grow in the garden, provided the frost is all gone, and before the summer is over there will be a fairly strong plant (not of course 10 feet high), with stem, leaves, and tassel complete. Explain that this "**tassel**" is the flower of the plant, and that just below it there should be the **ears**, each one carefully folded up in a leaf; but our climate is not warm enough to mature the ear.

This is the maize-plant as it grows here; but I want you to think what it must be like in the warm lands across the sea. There it is a great plant, 10 feet high. Think what a large amount of room each plant must take up in the field.

The corn-plants in our corn-fields grow close together in rows, and the rows themselves are only a few inches apart. These great plants require much more room than that.

When the ground has been ploughed and harrowed, the seeds after being soaked are dropped into little holes



about three feet apart, and this gives the plants plenty of room to grow. It also gives the men room to get between them, for they have to work very hard with the hoe, to cut up the weeds as fast as they grow. As the plants get bigger and bigger **the soil has to be heaped up** all round the roots, so that they may be able to get plenty of food.

In course of time the **tassels of flowers** begin to show, and soon afterwards the **cobb itself peeps out** from the broad leaf in which it has been folded up.

When the harvest-time comes, and the grain is quite ripe, the stalks are cut down one by one, and the cobs are twisted off and carried away.

Compare this with our own harvest. It would be impossible to cut down these great plants with a reaping machine as we cut our corn.

Show the cob once more, and call attention to the rows of closely-packed grains in it. The produce is greater than that of any of the other corn-plants.

III. RICE

Show some rice. Let the children tell that this too is a kind of corn—that it grows on a plant with hollow, jointed stalks, and long, narrow leaves or blades which spring from the joints—it is another of the corn-grasses.

Show a picture of the plant. Explain that this plant would not grow here; it would not grow even in the warm lands where maize grows. It will only grow in the very hot parts of the world.

Let us see how this kind of corn is grown. It requires plenty of water as well as heat. It grows best in places where the soil is wet, and the air always hot and moist.

In some countries the fields are flooded with water, till the soil is soft and muddy, and then the water is drained off, and the seeds are sown, either broadcast or in drills or rows. The grains sink into the soft mud, and quickly spring up, after which the fields are again flooded, and the little plants are soon seen peeping up above the water.

In other parts of the world the seed is sown first, and afterwards the field is flooded. But in either case the plants really grow in the water. The hot sun soon dries the fields, and then more and more water is let in from time to time, to cover them as the plants grow.

Explain that, of course, weeds grow as quickly as the plants themselves, and these weeds must be destroyed, or they would

kill the plants. Picture the labourers at work in the rice fields, often knee-deep in the soft mud.

Even when harvest-time comes the men have to wade in this manner through the soft mud, while they cut down the crop with their sickles.

The ears of rice when ripe are not unlike an ear of barley. Each grain is covered with a brown skin or



husk, and it is then known as "paddy." Before the grain is sent to us this outer skin is removed by crushing the "paddy" in a sort of mill, and this leaves nothing but the white glistening rice which we use.

Lesson VI

THE STAFF OF LIFE

Teacher should be provided with some oatmeal, barley-meal, corn-flour, and rice-flour, some pieces of cambric, four small basins, a jug of water, and a packet of Brown and Polson's corn-flour.

I. SOME EXPERIMENTS

COMMENCE by reminding the children of the experiment of washing the starch out of the flour in the muslin bag.

What kind of flour did we use for our experiment?
Wheaten flour.

What did we find at the bottom of the basin when the experiment was over? **Starch.**

What was left in the muslin bag? Some white, sticky stuff called **gluten**.

We are now going to have the same experiment over again. I shall want four girls to come to the front and do it themselves this time.

Provide a basin of water for each girl. Show some **oat-meal**, **barley-meal**, **corn-flour**, and **rice-flour**, and tell the name of each one. The name **corn-flour** should not be given at this stage, as it would probably cause a wrong impression. It will be quite sufficient to tell that this kind of flour is prepared from maize.

Mix a small quantity of each with water into a paste, tie them up in separate muslin bags, and set the four girls to knead the bags in the water between their fingers and thumb, as they saw it done in the former lesson—the teacher of course assisting where necessary.

Call upon the class to notice that, as the squeezing goes on, the water in each basin becomes white and milky-looking.

What does this tell us? It tells us that all these different kinds of flour are like wheaten flour, for **they all contain starch**.

What do you expect to find inside each bag when it is opened? White, sticky gluten.

Very well, we will see.

When the bags have been kneaded and squeezed sufficiently, proceed to open them, one by one. It would be best to begin with the rice-flour. If the bag has been well squeezed in the water it will now be quite empty. In any case there will be

no sign of the sticky gluten in it. Let the children examine it and see for themselves.

Remind them that the white sediment at the bottom of the basin is all starch. This rice-flour contains no gluten; it is nothing but starch.

Deal in the same way with the bag which contained the corn-flour, and show that there is no gluten in this. The starch, is all washed out into the basin, and the bag is empty.

If the other two bags be examined now, the children will at once appreciate the difference. In both of these there will be a residue of sticky gluten left behind, but the amount will be considerably less from the barley-meal than from the oatmeal.

Oatmeal is very rich in gluten; it contains even more gluten than wheaten flour. But barley-meal contains much less gluten than either of them.

II. BREAD IN DIFFERENT LANDS

1. Wheaten Bread.—Lead the children to tell all they can of the nature of gluten as a food. It is the best part of the flour; it is the gluten of the flour which helps to make our flesh and bones and blood. Flour without gluten in it would not make nourishing bread. Wheaten flour makes good, wholesome food because it is rich in gluten.

Let them next tell of the plastic properties of dough made from wheaten flour. The gluten of wheaten flour is very sticky; it binds well together, so that it can be easily moulded into a loaf.

Explain that these two things together make wheaten flour the best of all for bread. Everybody in England, rich and poor alike, eat wheaten bread. It is our staff of life.

2. Oatmeal.—Remind the children that oatmeal is even richer in gluten than wheaten flour. Why then do we not use oatmeal for bread?

Explain that the gluten of oatmeal is not quite the same kind of stuff as the gluten of wheat. Its particles, instead of

being very sticky, are loose, and will not hold together. Oatmeal will not make a light, spongy loaf because of this; but it makes flat cakes.

Lead the class to tell, in the next place, that oats are a very hardy kind of corn. They will grow in places where it is much too cold and damp to grow wheat.

Point out, as an illustration of this, that in some parts of the north and west of Scotland it is too cold for wheat to grow. But oats will grow where it is impossible to grow wheat, and in these places the people are able to provide themselves with a very excellent kind of food exactly suited to the climate in which they live.

3. Barley-meal.—We never use barley-meal for bread in this country, but in some lands where the people cannot get wheat they have to eat barley-bread. We should not like to exchange our white, soft, spongy bread for the harsh, black, barley-bread which is their staff of life.

In some countries, again, the people cannot even get barley. They make their bread of rye-flour, but this bread is darker, coarser, and heavier still than barley-bread. But it is the best they can get; it is their staff of life.

4. Maize.—Remind the children of the maize-flour which they examined just now. It contained no gluten. Its proper name is corn-flour; but that is the name given to it in America where the maize grows.

Explain that we in England give the one name corn to wheat, barley, and oats, but that in America corn always means maize. We use very little maize in England, except in the form of corn-flour.

This corn-flour is not the meal obtained by grinding maize in a mill. It is made by soaking the grains in water till they are quite soft, and then crushing them up between great rollers in a tank of water. As the crushing process goes on, the water becomes white and milky-looking. Why?

Lead the children to think of the flour in the muslin bag. The crushing and washing separate the starch from the grains, and it is the starch that makes the water milky-looking.

This corn-flour consists entirely of starch. We use it for making puddings, custards, blanc-mange, etc.

In America the people use the flour got by grinding maize in the usual way to make their bread. But even the pure maize-flour contains so little gluten that it cannot be moulded into a loaf unless it is mixed with wheaten flour.

5. Rice.—*Remind the children that the rice-flour they saw just now was pure starch. Show some grains of rice. That rice-flour was made by grinding grains of rice like these.*

Rice, as we see it, contains no gluten. We could not live on rice alone in a cold land like ours; but in India and China, and other hot parts of the world, the people eat little else. It is their staff of life. Rice, in fact, feeds more people than all the other corn-grains put together.

The rice which these people live upon, however, is not the same as that which we use. They eat it just as it is, without removing its brown outside skin or bran; and it is known as "paddy."

You remember that in all the corn-grains, whatever gluten there is always lies just underneath the outer skin. Although there is only a very small quantity of gluten, even in the "paddy" itself, yet the people get it all because they do not remove the bran.

Lesson VII

MILK

Provide a tin of condensed milk, pictures of milking-time, the dairy, and the arrival of the milk-train in the station.

A. INTRODUCTION

COMMENCE by showing the pictures of milking-time. This will at once awaken the memory and arouse the interest of the class. Lead the children themselves to describe the picture and tell

what is going on. The cows are being milked; the milkmaids milk them by squeezing the **teats** of the **udder** in their hands. The cows stand very quiet while they are being milked. It eases them and makes them feel more comfortable to have the milk taken away.

Why is the cow provided with milk? She wants the milk to feed her little calf at first, while it is very young. When it gets old enough it eats grass as she does. It does not want milk then.

Why do we milk the cow when her calf is old enough to eat and can do without its mother's milk? We want the milk for ourselves.

How often does the maid milk the cows? She always milks them twice a day—**morning and evening**—and sometimes at **noon** as well.

How much milk does she get from each cow? A good cow gives from **8 to 12 quarts** of milk a day.

What does she do with those large pails of milk? She takes them into the **dairy**.

Lead the children to describe the dairy. It must be a cool, shady, airy room. Why? The dairy itself and everything in it must be spotlessly clean. Why?

Show the picture of the dairy now.

What is the meaning of all these **large, shallow pans** on the shelves? They are to hold the milk.

Why is the milk put into these pans? It has to stand in them till all the **cream** has floated up to the top.

What does the dairymaid do with it then? She skims it off the top of the milk with her skimmer.

What does she call the milk which is left behind with all the cream taken out of it? **Skim-milk.**

What does she do with the cream? She makes the cream into **butter**.

Let the children point out the churn in the picture. Lead them to tell what they can about its work, so far as this has been dealt with in the earlier lessons. It will be an easy matter to make them tell the purpose of the churning, if they are first led to describe, in their own way, the nature of the cream.

The churning, then, bursts the thin outer skin of those tiny balls, and sets the fatty matter in them free; and that fatty matter is butter. But what is left in the churn when the churning is all over, and the butter has been taken out? The liquid left in the churn is butter-milk.

What else is made from milk besides butter? **Cheese.**

Is cheese made of cream, too? No, cheese is made of the **curd** of milk.

How do they get the curd out of the milk? They put **rennet** into the milk and that **curdles** it.

Let the class tell briefly what rennet is.

What is this curd of milk like? It is **white, solid stuff**, not a liquid like milk.

What name is given to the rest of the milk when the curds have been taken out of it? **Whey.**

How is the curd made into real cheese? It is cut up into small pieces, and then squeezed in a press to squeeze out all the liquid from it.

II. MILK FOR OUR DAILY MEALS

Fresh Milk.—Lead the children next to think of the milk, as they see it on the table, in its simple state. We use milk at all our meals. To town children the **milkman**, with his cans of milk, is a familiar sight. But where does he get the milk that he carries round from house to house day after day? He is an early riser. Long before we are awake he has to be up and doing. Show a picture of one of our great railway stations at the arrival of the milk-trains. Explain that the milk which we see on our breakfast table has most likely come a long, long journey by train—it has been travelling all night, perhaps, to be ready for us in the morning—it all comes up from the country. Describe the scene of bustle at the station when the great milk cans are rolled out of the trucks and put into the carts and runs of the milkmen to be carried away in all directions. What a noise they make as they rattle off! Tell that, to supply the wants of London alone, it requires all the milk from **60,000 cows**, supposing each cow to give 10 quarts every

day. This, of course, is only to supply the daily milk, which is brought round to our houses, or sold in the milk-shops.

2. Condensed Milk.—Show a tin of condensed milk. This of course will be quite familiar to the children. Lead them to tell all they can about it. When it comes from the shop it is always closed up tight; before we can use it we must cut the tin open with a knife. It does not look like milk—it is like a thick paste.

Now let us see how this condensed milk is prepared. The fresh, new milk is put into boilers and gently heated, so as to keep it just on the boil.

What have you yourselves seen coming out of the spout of the kettle when it has been boiling on the fire? Steam.

What does that tell you? Some of the water has been changed into steam and is passing away.

Quite right; we say the water is boiling away. It is just so with the milk. As it boils, the water part of it changes into steam and passes away, and the milk gets thicker and thicker, because there is less water in it. This is why it is called **condensed milk**. Condensed milk only means **thick milk**. It can be easily made thin again like fresh milk by adding some water to it.

When the milk has been condensed, or thickened enough, it is put into tins like this, and closed up tight to keep the air from it. It will keep for years if it is not opened.

Most of the condensed milk we use has sugar added to it before it is put into the tins; but some sorts are closed down without being sweetened at all.

III. THE VALUE OF MILK AS FOOD

Now let us think once more of the little calf in the field with its mother. It cannot eat grass, because its teeth are not grown strong enough; but the milk, which its mother gives it, contains everything that is wanted to make the little thing grow bigger and stronger.

You have seen me get two very different sorts of things out of milk. What are they called? **Cream** and **curd**.

Quite right. Now let us take these one at a time. The curd, of course, is in the milk at first, although we do not see it till we put in some rennet. The little calf uses this curd part of the milk, which its mother supplies, to build up its body and make it grow bigger and bigger.

The cream, you know, is fat, and this helps to keep its body warm, and give it strength to move about.

You and I as well as the little calf must have both these sort of things in our food. We must have something to make our bodies grow, and something to keep us warm. This explains why milk makes such splendid food for us as well as for the young calf.

Lead the children to think of the gluten and starch of wheat, and show them that, for a similar reason, bread made from wheaten flour makes excellent food. The curd of milk is something like the gluten of wheat—it builds up our bodies. The cream is something like the starch—it keeps our bodies warm. Milk in itself contains everything that is wanted to support life.

Lesson VIII

BUTTER

Have in readiness pictures of the dairy (with upright, barrel, and modern churns), and the cream separator.

L. INTRODUCTION

Show the picture of the dairy.

Tell the class that they are now going to learn something more about the work of butter-making, but that they must in the first place look carefully at the picture and tell all they can about it.

It will be an easy matter, with the assistance of the picture, to lead them to describe the work of the dairy, as it has been told in the earlier lesson. They should now be quite familiar with the simple principles involved in each part of the work—the

separating of the cream, the churning process, and the washing and kneading of the butter after it has been made. This, of course, was the sole aim of those lessons.

Explain that our picture shows us the old-fashioned style of butter-making. This did very well where only a little butter was to be made, perhaps twice or three times a week. It does very well now in many small farmhouses in the country. But it would never do where large quantities of butter have to be made every day.

Call attention to the pans on the shelves in the picture. The milk in those pans has to stand a whole day, and sometimes part of the next day, before all the cream or fatty part of the milk has floated up to the top.

Where much butter has to be made the farmer has been obliged to find out quicker ways of doing the work.

II. SEPARATING THE CREAM

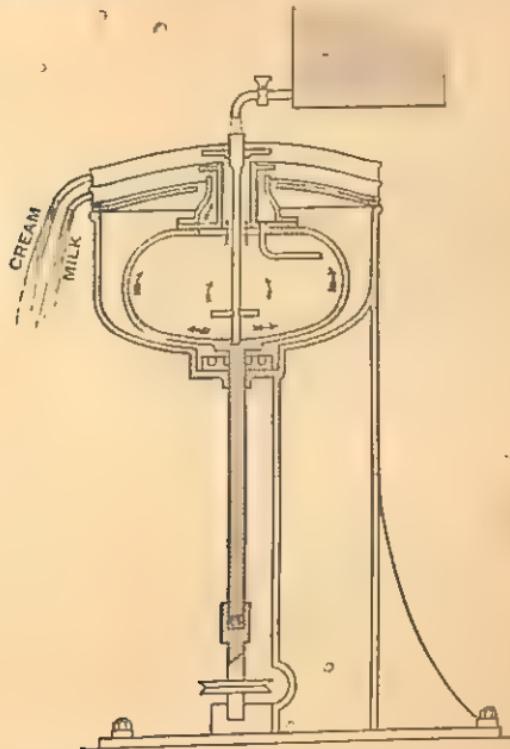
Of course the first step in making the butter is to get the cream away from the milk. Let me show you how this is done now on our large farms. Here is a picture of a very curious machine called the **cream separator**. This clever machine separates every particle of cream from the milk in a very few minutes; and there is **no need for the milk to stand**, it is put into the machine just as it comes from the cow.

As the milk-pails are brought in one by one, the milk from them is strained through a cloth sieve into a great can. This is to get rid of hairs, pieces of straw, wood, or other things that sometimes fall into the pail while the milking is going on.

There is a tap at the bottom of the can, and when this is turned on, the milk flows out of the can into an iron chamber at the top of the cream separator. Inside this chamber are a number of metal flaps or beaters. These are made to whirl round rapidly by steam, thousands of times every minute. As they move round they set the

milk in the chamber in motion, and the cream, which is lighter than the rest, is carried upwards to the surface.

There is a tap in the top of the chamber, and through this the cream flows out into a vessel placed to receive it. The skim-milk flows out, too, but through a tap lower



down, and all the time more and more fresh milk is coming in from the great can above.

In fact, the work of separating the cream goes on as rapidly as the fresh milk can flow in.

III. CHURNING THE BUTTER

Show a picture of the old upright churn, and tell how it was worked. Explain that the work of butter-making with this old churn was very hard labour, for it took two or three

hours for the butter to form, and all this time the dairymaid must keep the handle moving up and down without stopping. If the cream inside were allowed to rest for ever so short a time the butter would not come.

Show a picture of the barrel-churn, and describe it."

The inside of this churn is fitted with a number of **wooden flaps** or **beaters**, and when the maid turns the handle the cream dashes and splashes about against them, till at last the butter is formed.

Lead the children to see that it is much easier work to turn a handle like this than it was to move the beater of the other churn up and down through the cream. The barrel-churn was a great improvement upon the old upright churn, but even this would not do now in our great butter-farms.

Show a picture of the modern churn. Explain that there is not much difference in the box or barrel, but this churn is worked by a small steam-engine instead of being turned by hand. From twenty minutes to half-an-hour is the time it usually takes now for the butter to come, and the engine does the work much better than it could be done by hand, for it keeps the churn going at one regular pace—neither too fast nor too slow:

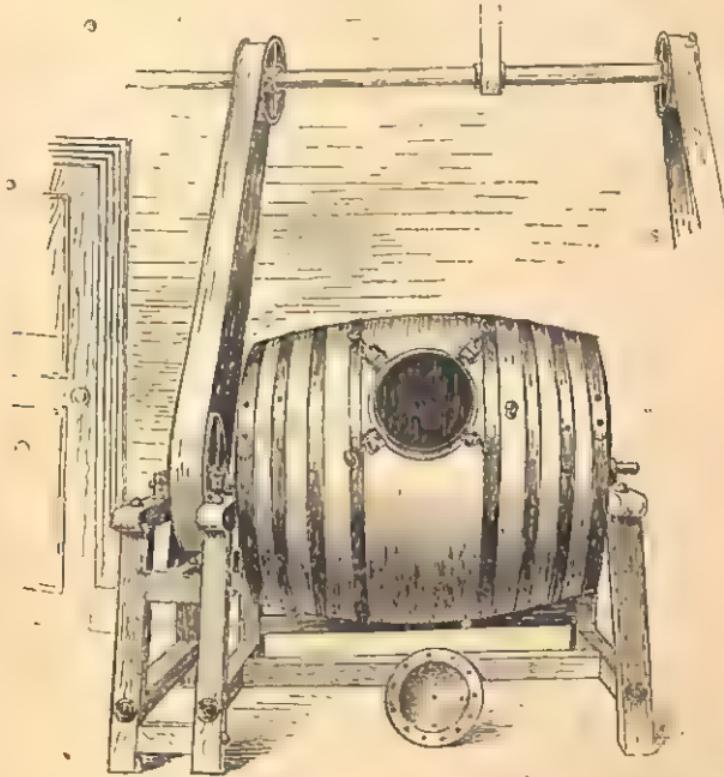


IV. CLEANSING THE BUTTER

When the lumps of newly-made butter are taken out of the churn the most important part of the dairymaid's work lies before her. Every drop of the **butter-milk** **must be got out** of the butter, for it quickly turns sour, and if any of it were left in the butter would **soon become rank**.

This part of the work can only be done by washing the butter again and again in clear spring water and then kneading it with the hands.

Picture the dairymaid at this part of her work. A careless, lazy girl, by only half rinsing the butter, to save herself trouble, would soon find the whole of the churning spoiled. She



must use every care in washing, and squeezing, and kneading the butter to be sure none of the butter-milk is left behind.

Picture her, too, in herself and all the vessels and other articles she uses. She never touches the butter till she has thoroughly cleaned her hands, and everything she uses is scalded and cleansed before it is put away, for the least dirt would spoil all her work.

The last thing is to **salt the butter**, for without salt

it would not keep. Even the **fresh butter** which we see in the shops in **rolls or pats** must have some salt added to it to improve the taste.

The butter which we see in wooden tubs is **salt butter**. This was well salted before it left the dairy, and it will keep for a long time.

*Explain that in the great dairy-farms even this work of washing and kneading the butter is now done by machinery. The machine, which is called a **butter-worker**, crushes and works up the butter by means of a roller turned by hand or by steam, and all the time water is made to flow over it to wash away the **butter-milk**. This makes the dairymaid's work much easier.*

Lesson IX

CHEESE

Place on the table a glass of milk, some vinegar, and some rennet, and have at hand pictures of the cheese-house and the cheese-press.

I. INTRODUCTION

OUR lesson to-day is to be about cheese and cheese-making. Which part of the milk is used for making cheese? **The curd.**

You saw me once take the curd out of some milk. I want one of you to do it now. How would you do it? Put some vinegar into it.

Produce the glass of milk, and let one of the girls come to the front and pour a few drops of vinegar into it. While the milk is curdling proceed as follows:—

Do the people who make cheese curdle their milk with vinegar? No, they use **rennet**, not vinegar.

What is rennet? It is a liquid, made by soaking pieces of the stomach of a calf in boiling water.

Does rennet curdle milk just as the vinegar has curdled

this in the tumbler? Yes, but rennet does it better than vinegar.

Show, if possible, a little stewed fruit of some kind in a saucer. Lead the children to tell that when they eat stewed fruit at home they like plenty of sugar with it. Why? The juice is very sour.

Pour some milk into the juice, and show that it at once begins to curdle just as the milk in the tumbler did.

Why do the vinegar and the juice of the fruit both curdle the milk? They are both **sour liquids**.

Then, as **rennet** curdles milk too, what kind of liquid would you expect that to be? **A sour liquid.**

If possible, have some actual rennet at hand, and let it be tasted. Remind the children that it is so sour that half a pint of it is enough to curdle a hundred gallons of milk.

II. CHEESE-MAKING

Show the picture of the cheese-house, and lead the children to tell all they can remember from their earlier lessons about it, and the work which is done there.

Like the dairy, it must be cool, fresh, and wholesome. Why? Because nothing so soon goes bad in a dirty, close room as milk.

Point out its cool, stone floor, its large, open, airy windows, and its rows of great troughs or tubs ranged round the walls. Tell that those great tubs are to hold the milk which is to be made into cheese.

1. Separating the Curd.—The milk is warmed before it is put into the tubs, and then the rennet is added.

Can you tell me how much rennet is required? Half a pint of rennet is enough to curdle a hundred gallons of milk.

Quite right; and nothing else has to be done after the rennet is put in but to stir it well up, and leave it to stand for about an hour.

If you looked into the tub at the end of that time what would you see? Pieces of white, solid **curd** floating about in a clear liquid.

What is the liquid called? **Whey.**

*Call attention once more to the picture, and show how the curdled milk—**curds and whey**—is run off from the tubs and strained through canvas cloth. Tell that the clear whey drains through the canvas into the vessel below, but the solid curd is held back, and collected up for further treatment.*

2. Drying the Curd.—The curd at first contains a large amount of whey. It is of course soaked in the whey. Every drop of this must be got rid of by some means, or the cheese would quickly turn sour and spoil. Let us see how this is done.

The curd, as it is collected from the strainer, is first cut up into small pieces, and then put into a vessel called the **cheese-vat**. When the vat is full it is covered with a cloth, and the curd is pressed by hand. There are holes in the bottom of the vat, and the liquid which is squeezed out of the curd by the pressing runs away through them.

When it has been pressed enough it is taken out, cut up again into small pieces, and once more put into the vat to be treated in the same way. After this second pressing the curd is nearly dry, and much harder than it was.

3. Making the Cheese.—Think for a moment of our last lesson on butter-making. What has to be done to the butter to make it keep good. It has to be salted.

It is just the same with cheese. **The curd would not keep long without salt**, and the next work is to salt it.

When the lump of dry, hard curd is taken out of the vat it is broken up into pieces about the size of a walnut, and well mixed with powdered salt. About a pound of salt is mixed with twenty pounds of the curd.

The curd, properly salted, is next put into a canvas bag and stood in the **cheese-press**. This is a sort of mould the same shape as the cheese is meant to be.

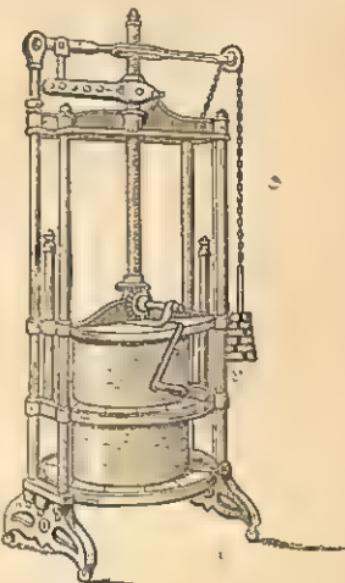
Show a picture of the cheese-press. Tell that it not only presses and moulds the cheese into the proper shape, but at the same time squeezes out any of the moisture that might still be left in it.

Every morning it is turned about and carefully

examined, and after about four or five days it is fit to be taken out of the press.

The canvas bag is then removed, and the cheese is placed with others on a shelf in a large, dry, airy room, known as the **drying-room**. Here they are kept for months, and every few days they are turned about, till at last they gradually become quite dry and fit for market.

If time permit the children may be called upon to name some of the most familiar kinds of cheese, the teacher assisting where necessary. Too much, however, need not be made of this now. It would be quite sufficient to show them that different cheeses have different shapes and sizes. This part of the subject will be dealt with later.



CHEESE PRESS.

Lesson X

SALT

Articles required : a lump of common table-salt, some strong brine, some rock-salt, a jug of water, a saucer, two or three tumblers, an evaporating dish and tripod, the spirit-lamp, or the Bunsen burner, and a picture of a salt mine.

I. INTRODUCTION

Show the lump of common table-salt, and commence as usual by assisting the children to recapitulate briefly and rapidly the leading points of the lesson in the earlier stage.

A few simple questions (with the piece of salt at hand) will serve to awaken the memory, and arouse the interest of the children, so as to make them tell what they have already been

tought of the nature and properties of salt, and the chief uses to which it is put. This will be enough to prepare the way for what is to come.

II. SOME EXPERIMENTS

Place a piece of salt on a saucer, and slowly and gently let a little water drop on it. Call upon the class to tell what they observe.

What becomes of the water? It **soaks into the salt**.

What can you tell me then about the salt? The salt must be **porous**. It takes the water into its pores.

Think of our experiment with the piece of bread and the sponge; they take in water into their pores. What do we say about them? They are **absorbent**; they **absorb the water**.

Quite right; and now you see **salt absorbs water too; it is absorbent**.

Continue to pour water on the salt, and show that by degrees the little grains of which it is composed become loosened, and separate from each other, the whole falling in a heap in the saucer.

Take up the heap of wet salt now, and put it into a glass of warm water. Stir the water till the salt gradually disappears, and let the children tell what has happened.

You noticed that the salt at first sank in a heap at the bottom of the glass. But where is it now? What has become of it? **The salt is dissolved**.

What does that mean? It means that **the water has broken the salt up** into such tiny pieces that **we cannot see them**.

How can we prove the salt is there, although we cannot see it? By tasting the water.

Quite right; and remember we could not take out the smallest drop of this water without taking some of the dissolved salt with it. What does that prove? It proves that the little particles of salt **have been scattered all through the water**.

The fact is, the salt began to break up as we poured water on it in the saucer ; and as soon as we emptied the saucer into the tumbler, the grains of salt became more and more broken up, loosened, and separated from each other, till they were scattered into every part of the water.

Now I want you to try to remember three hard words, which mean all I have been showing you.

1. Because the little grains of salt become loosened from each other in this way when put into water, we say **they dissolve**. **To dissolve** means **to loosen or separate**.

, 2. Because the salt dissolves in the water, we say it is **a soluble substance**.

3. Because the water holds this dissolved salt, it is said to be **a solution of salt**.

Show the tumbler of strong brine. Let one of the children dip her finger into it and taste it.

What have we got in the tumbler ? A solution of salt.

But we cannot see the salt. How do we know it is there? We can taste it.

Yes ; and it tastes exceedingly salt. We say it is **a strong solution** because there is so much salt in it. We call it **brine**.

Now we will put some of the brine into this tin dish, and let it boil over the lamp. See what takes place. The water in the dish soon boils, and we see it flying off in clouds of steam.

Let the boiling continue until all the water has disappeared in steam.

Explain that nothing but the water itself can pass off as steam. Whatever is dissolved in the water will be left behind.

Scrape the salt together into a heap in the dish, when all the water has passed away, and show that all this solid matter was held in solution in the water although we could not see it. While it is cooling evaporate some ordinary water in another dish, and show that in this case there is nothing left behind.

No, we have nothing in this dish, but let us examine the first now that it is cool, and see what we have there.

Let the children take it in their hands, examine it, and taste it, to make sure that it is really salt.

What have we left behind then in the dish, after all the water of the brine has boiled away? This is the solid salt which was held in solution in the brine.'

Quite right; and remember we have got the solid salt back by boiling the brine.

III. TABLE-SALT AND ROCK-SALT

Show the lump of rock-salt, and lead the children to tell all they can about it. All the salt we see was once just like this. It looks like a smooth, shiny, reddish brown stone; we call it rock-salt. It is a mineral; it is found in great solid beds, which stretch for many miles deep down in the earth.

Put some pieces of it into a tumbler of warm water, and let the children see that it dissolves like ordinary table-salt,

Now let us think of those great beds of rock-salt under the ground.

What would happen if water were constantly soaking through these beds? The water would dissolve some of the salt and make brine.

Well, this is just what does happen. You know that every time it rains some of the rain soaks into the ground. Wherever the rain soaks into a place where there are any beds of salt underground, it always dissolves some of the salt as it soaks through, and becomes brine.

Explain that all our white, crumbling table-salt is made from this brine.

In order to get the brine, men bore a hole through the ground into the beds of salt, and put a long pipe down the hole. The brine runs into this pipe at the bottom, and then they pump it up.

Think for a moment about our experiment just now, and you will be easily able to tell the rest. How do you think they get the white table-salt from the brine? It is

got from the brine just as we got the salt from the brine by boiling away the water. But to provide all the salt we want for use the brine has to be boiled in great pans as big as a room. The water of the brine is all boiled away, and leaves the white salt behind. But remember the brine itself came from the rock-salt beds underground.

IV. THE SALT-MINE

Explain that people sometimes dig deep mines in the earth to get the rock-salt itself, just as we dig mines to get coal and iron.

Show a picture of the salt-mine. Describe it. It is like a great town underground. The miners, with their wives and children, live in the mines, and seldom come up to the light of day above ground.

The horses that draw the wagon-loads of salt through those underground streets never come up again when once they are taken down.

Houses for the people and stables for their horses are all cut out of the solid bed of rock-salt.

Lesson XI,

SUGAR

Teacher will require some wax, some Demerara sugar to show the large crystals, some foot sugar, some treacle, a piece of sugar-cane, an iron spoon, the spirit-lamp or the Bunsen burner, pictures of the sugar-cane, one of the corn-grasses, the sugar-harvest, and the sugar-mill. The crystals of alum should be prepared beforehand in readiness for the lesson.

I. PROPERTIES

OUR lesson to-day is to be about sugar, and you remember of course that a few days ago we had a lesson on salt.

Now think for a moment, and tell me in what respect sugar and salt are alike. They both **dissolve** if they are put into water.

Quite right; but what does that mean? It means that the water breaks up the sugar and the salt into such tiny pieces **that they cannot be seen**.

What do we say about things that dissolve? We say they are **soluble**.

If we cannot see the salt or the sugar in the water, how do we know they are there? We can find out by tasting the water. They make the water taste.

Remind the children of the sweets which they suck. These sweets are made of sugar.

All children are very fond of sweets; but how is it that we can taste them? Explain that the **moisture in the mouth dissolves the sugar** and so becomes sweet itself, just as the water in the tumbler would if we put some sugar into it.

Would it be right to say the sweets melt in our mouth? Let us see.

An experiment.—Put a piece of wax in an iron spoon, and hold it over the flame of the spirit-lamp. Call upon the children to notice that the wax is at first a solid lump, but after a time it **changes to a liquid**. They can see it flow about in the spoon. **The wax is melted.**

Proceed to do exactly the same thing with some sugar, and point out that the sugar, in like manner, **changes from a solid to a liquid**, and flows about in the spoon. We have melted the sugar just as we melted the wax. Both will become solid again when they get cool.

So then the **heat of the flame melts the sugar** by changing it into a liquid; **water dissolves it** by breaking it up into such small particles that they disappear altogether. We know the sugar is there only by tasting the water, just as we found out the salt in the water by tasting it. These things, sugar and salt, are **dissolved, not melted, in water**.

You have told me how, in one respect, sugar and salt are alike. Now think what these two things are, and you

will be able to tell me in what respect they are not alike. Salt is a mineral ; but sugar is made from the juice of a plant.

Quite right. Now suppose we have a talk about this plant next.

II. THE SUGAR-CANE

Here is a picture of it. What is its name? It is called the **sugar-cane**.

Yes it is ; but before we say anything of the sugar-cane itself, I want you to think about some other plants which we have had a great deal to do with lately. I mean the corn-plants.

What name do we sometimes give to these corn-plants? We call them **corn-grasses**.

Why? Because they are really a kind of grass.

Show a picture of one of the corn-grasses, and lead the children to point out the special features of the plant—the tall, jointed stem, the long, narrow, ribbon-like leaves springing from the knots or joints in it, and the bunch of green flowers, which in time become ears of corn, at the very top.

Now call attention to the sugar-cane. Show that this plant, too, has a jointed stem, with long, narrow, ribbon-like leaves springing from the joints, and (when it is ripe) a bunch of flowers at the very top.

The sugar-cane is a sort of grass, although it is very tall and strong, for it grows 10, 12, and sometimes 20 feet high. The stem is not only tall, but stout and thick too. When it is fully grown it is quite two inches thick.

What do you notice about the stems of most grasses. when they are cut across? They are all **hollow stems**.

Quite right; but the stem of this grass, the sugar-cane, is solid.



Show a piece of the actual cane itself, if possible. Call attention to its loose, spongy structure, and lead the children to tell that in the growing plant the stem is filled with a watery sap.

When the canes are quite ripe, the beautiful white and lilac flowers at the top of the stem begin to show, and the stem itself becomes very sticky, because of the juice which oozes through.

The juice is then very sweet; it smells and tastes something like a ripe apple. The juice is sweet because it contains sugar, but if we could collect and examine some of it we should not be able to see any sugar in it. Can you tell me why this is? The sugar is dissolved in the juice; although it is there it is in such tiny particles that it cannot be seen.

When the flowers begin to show the sugar-harvest is ready.

Lead the children, by recalling the lesson in the earlier stage, to describe the cutting and carting of the canes, and the manner in which the juice is obtained by crushing them in the sugar-mill.

Pictures of the sugar-harvest and the sugar-mill should be shown.

III. HOW SUGAR IS GOT FROM THE JUICE

I want you to remember what happened in our last lesson when we boiled the brine. The water boiled away, and the salt was left behind in the dish.

Exactly. In other words, we got back the dissolved salt by boiling the brine.

Make a solution of sugar, and repeat the process of boiling.

Let the children examine and taste the sugar that is left behind in the dish, and so lead them to see that the result is the same as in the other experiment.

Point out that this sugar is not in grains like the sugar they see in the shops, it is a thick, solid mass, more like toffy than anything else.

Show the specimen of Demerara sugar, and call attention to the large grains. Tell that these are called **sugar crystals**.

The following experiment will give a graphic description of the way in which the crystals are formed. Prepare, a few days before the lesson, a hot saturated solution of alum, and in it hang some small wire article, first covering the wire with worsted. Nothing more is necessary but to stand the vessel aside and leave it to cool slowly; then when it is wanted for the lesson, the article (a little wire basket will do as well as anything) may be taken out and shown to the children. The worsted will be seen covered with glistening crystals, the formation of which the teacher should first explain, and then apply it to the forming of the sugar crystals.

The same thing may be done with sugar, and the crystals will collect on strings of worsted, if they are hung in it; but as alum makes the best crystals, it would be well to show that first.

The juice from the canes is put into large copper boilers, and there allowed to boil rapidly. Some lime is thrown into the boiling juice, and this causes all the **impurities to rise to the surface** as a thick scum. This scum has to be carefully skimmed off from time to time as it rises.

While the boiling goes on the water passes away in steam, and the juice thickens into a syrup. When the syrup is thick enough, it is run off into wooden vessels and left to cool slowly.

As it cools most of it separates into grains or crystals, something like those on our basket. Some of it will not form into crystals, but remains a thick, coarse, brown liquid, which we call **molasses or treacle**.

The children themselves should be made to tell how the treacle is separated from the sugar crystals. The mixture of sugar and molasses is put into casks with holes in the bottom, and there allowed to stand till all the liquid part drains away, and only the sugar is left in the casks.

Tell that the coarsest part of the sugar sinks to the bottom of the cask; it is known as **foot sugar**, because it comes from the foot or bottom of the cask.

Lesson XII

LOAF-SUGAR

Provide some raw and loaf sugar, powdered bone-charcoal, chalk, coloured water, blotting-paper, filters, two or three tumblers, a small flower-pot, a glass funnel, and a sponge.

I. INTRODUCTION

Show the specimens of raw and loaf sugar. Lead the children to tell that both were prepared from the sweet juice of the sugar-cane; that this white, glistening loaf-sugar was once coarse and brown like the other; and that instead of being a solid lump as it is now, it was then in the form of loose grains or crystals, exactly like those in the saucer.

All the sugar obtained from the boiling juice is at first coarse and brown like this.

But what makes the sugar coarse and brown? It is dirt and other impurities which give the sugar its brown colour.

Explain that the raw juice, as it comes from the canes, has a large amount of dirt and other impurities mixed up with it. Remind the children that, when the juice is put into the pans, lime is thrown into it. This is for the purpose of causing these impurities to rise and form a scum on the surface, and this scum is carefully skimmed off while the boiling is going on.

It is impossible, however, to get rid of all the impurities. There is always some solid matter left behind, and this becomes mixed up with the sugar as it forms into crystals.

II. FILTERS

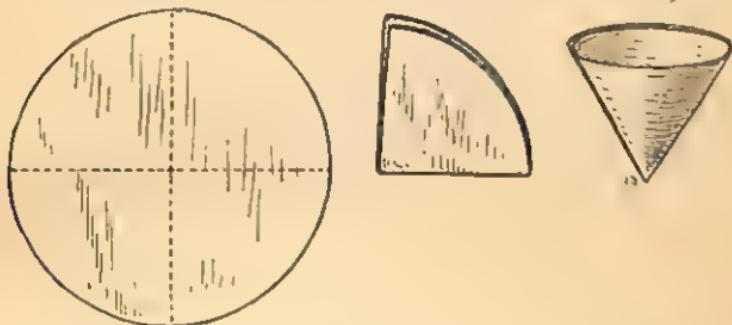
Cut out a few circular pieces of blotting-paper about 6 inches in diameter. Take three of them, and fold them twice at right angles across the centre, and then open them out so as to form a sort of conical basin. Stand this when made in a

glass funnel, and then proceed to mix some sugar and water in another glass. Stir it well up, and let the children tell what takes place.

What has become of the sugar? It is dissolved.

How do we know that? It has disappeared in the water; we cannot see it; but we could find that it is there by tasting the water.

What would happen if we poured the water out of the



glass? We should pour the sugar out too; we could not pour away the water and leave the sugar behind.

Now put some powdered chalk in the same water, and stir it well up. Tell what has been done, and lead the children to see that we have now two things mixed up in the water—sugar and chalk.

The sugar you say is dissolved; is the chalk dissolved too? No; we can see the chalk floating about in the water. **We should not see it, if it were dissolved.**

Leave the water to stand for a short time, and call upon the children to notice that the chalk gradually settles at the bottom of the glass. When it has settled, show that it would be an easy matter to pour the water away, and leave all this chalk behind. Let them taste the water. **The sugar is still there although we cannot see it.**

Now stir it up once more, and pour it into the blotting-paper. Call attention to the water as it trickles through the paper into the tumbler below. **It is quite clear now; not white with chalk as it was when it was poured in.**

Show that all the chalk has been held back inside that blotting-paper basin; only the clear water has trickled through.

You have seen the water come through; what then can you tell me about the blotting-paper? It must be porous.

Yes; it is porous. But why did it not let the chalk through as well as the water? Its pores are too small to let the little bits of chalk pass.

What else was there in the water besides chalk?
Sugar.

I wonder whether the blotting-paper has kept back the sugar as well as the chalk. Let us find out. What shall we do? Taste the water.

Let the children test the water by dipping a finger into it and putting it to their tongue. The dissolved sugar is still in the water; the blotting-paper has not been able to hold that back as it did the chalk.

Now let me explain what we have been doing. Our blotting-paper basin is a very simple kind of **filter**. It allowed the water, with the sugar that was dissolved in it, to pass through its pores, but it held back the solid particles of chalk. Do you remember seeing anything like this before?

Lead the children to think of last year's experiment with the flannel bags and the muddy water. The flannel was porous, and the bags made a filter. We filtered the muddy water through them. The pores in the flannel allowed the clear water to drip through, but they were too small for the particles of mud to pass.

I have now another simple sort of filter to show you. Here is a small flower-pot. I will first plug up the hole with a piece of sponge, and then half-fill the pot with some of this black powder.

Tell that this is **charcoal**. Explain briefly what it is, and how it is made. Show a specimen piece, and point out that it is a very porous substance. It is full of small holes.

After this brief explanation filter some coloured water

through it, and let the children see it drip through quite clear and colourless.

III. HOW THE SUGAR IS REFINED

Now that you know the nature of a filter, you will be able to understand how the coarse, brown, raw sugar is changed into this white loaf-sugar.

Make a syrup of each kind of sugar, and point out that the one made from the brown sugar is thick and of a dirty brown colour, while that made from the loaf-sugar is clear and colourless.

Can you see the sugar itself in either of the glasses? No; we cannot see the sugar because it is dissolved.

Then it is not the dissolved sugar in this liquid which gives it its brown colour. What makes the liquid brown? It is brown because of the solid matter which is mixed up with this coarse raw sugar.

What would happen if we poured the liquid into a filter? The water, with the sugar dissolved in it, would filter through, quite clear, but the solid particles would be held back.

Explain that this is exactly what takes place in the sugar refinery. The dirty-looking, brown syrup, made from the coarse raw sugar, is first passed through the thick woollen filtering bags, and afterwards through a bed of charcoal, and when at last it filters through, it is clear and colourless, just like the syrup we made from the loaf-sugar.

The filters allow the dissolved sugar to pass through, but keep back all the solid impurities.

Astir the children, by recalling the old lesson, to tell the remaining operations of boiling the clear syrup, filling the moulds, and draining the golden syrup from the solid sugar-loaves.

Lesson XIII**TEA**

Articles required for illustration : specimens of black and green tea, a sprig of myrtle, some fresh-gathered leaves from the garden, a few flabby wilted leaves, pictures of the tea-plant and a tea-plantation.

I. INTRODUCTION

Show the specimen of tea, and commence by calling upon the children to tell what it is. Each of these little knobs of tea is the dried, rolled-up leaf of the tea-plant.

How do we prepare the tea for our meals? It has to be steeped in boiling water.

What happens to it then? The boiling water makes the leaves uncurl, and draws out from them all their flavour and goodness.

What do you afterwards notice about the water itself? It is brown in colour, and has a pleasant taste and smell. This is the tea which we drink at our meals.

What is done with the leaves? They are thrown away, because they are of no further use.

It will amuse the children to hear the story of the lady who boiled the tea, threw the water away, and served up the leaves as a vegetable for dinner. Tell that when tea was first brought to this country it was very, very dear. It could not be bought for less than sixty shillings a pound. A friend of this lady sent her a pound of tea as a present, but did not say how it was to be prepared; and as she had never seen tea before, she did not know what to do with it, and so she made this funny mistake.

II. THE TEA-PLANT

Show a picture of the tea-plant; and lead the children to describe it as far as they can, by referring them to their earlier

lesson. It is an evergreen plant, and bears pretty white and yellow flowers. See that the term evergreen is clearly understood. Illustrate, as before, by a few familiar examples.

Call attention to the enlarged picture of the leaves and flowers, and elicit from the class a simple description of the leaf. It is long, narrow, and pointed—of a bright, glossy green colour—and its edges are jagged like the teeth of a saw.

Why do I show you evergreen leaves like the holly, myrtle, and laurel, instead of some of the green leaves of the tea-plant itself? The tea-plant does not grow in our country; it grows in hot lands across the sea.

Show a picture of a tea-plantation.

Here is a picture of a great field, in which hundreds of tea-plants are growing side by side in the open air. The best place to grow the tea-plants is on the sunny hill-side, where they can get plenty of light and air.

The seeds are sown in the early spring, and as soon as the young plants are big enough to be moved, they are planted out in long rows, just as you see them growing in the picture.

They grow quickly, and would in time become as tall as a small apple-tree; but the men who grow them cut and prune them, so that they never reach more than 3 or 4 feet in height.

The plants are allowed to grow like this for four years, and as fast as they grow they are cut back. This makes them thick and bushy, and after they are four years old the first leaves are gathered.

The leaves have to be picked very carefully, by hand, one at a time. The picking is mostly done by women; and all through the season they go from plant to plant, picking the tender young leaves as they burst open. The young leaves make the best tea; they would lose their flavour if they were left to grow old and tough.

Show a sprig of myrtle, if possible. Tell that the tea-tree belongs to the same family of plants as this. Call attention

to the young budding leaf at the top of the large, old leathery leaves. Break it across, and show that this is crisp and tender, and not tough and leathery like those below. It is exactly so with the leaves of the tea-plant.

III. HOW THE LEAVES ARE PREPARED

Hand round the class a few fresh-gathered leaves from the garden. Let the children squeeze them in their hands, and call attention to the juice which they have squeezed out of them.

Lead them to tell that this is the sap.

Show next a few of the same leaves which were picked some time before, and have been since lying exposed to the air. They are now darker in colour, and very flabby and wilted. Show that they may be rolled up and squeezed in the hand without breaking them and letting out their sap as the others did.

Now let us find out what this has to do with the leaves of the tea-plant. The fresh-picked leaves are thrown into a heap and left to lie there exposed to the air for a few hours. This turns the green leaves to a brown colour, almost black, and if you could handle them then you would find them quite limp and flabby, just like the wilted leaves we have on the table.

Remind the children of the change which takes place in the boiling water when we pour it on some tea. It not only becomes brown in colour, but it also draws out the taste and smell of the tea itself.

Explain that all these properties came from the sap in the leaf. The great thing to be done in preparing the leaves is to prevent any of this sap from oozing out and so being lost.

The leaves, after lying in the sun, are dried slowly, and then roasted in large flat pans over a fire. This has to be carefully done, for the object of roasting is to drive off the liquid part of the sap without burning the leaves.

I have a very curious thing to tell you now. The green leaves as they are picked have no smell—no taste

of tea. The smell and taste only come when they have been roasted.

When the leaves have been roasted sufficiently men take them, just as they come from the pans, and roll them up in their hands. It is this rolling that curls the leaves up into the shape in which we find them.

Lastly, show some green tea. Compare it with the specimens of black tea already shown. Tell that both are prepared from the same leaves, but that in the preparation of green tea the leaves are dried and roasted as they are picked, instead of being thrown into a heap and left exposed to the air.

Lesson XIV

COFFEE

The teacher should be provided with some ground coffee, some coffee-beans, raw and roasted, a kettle of boiling water, a cup and saucer, a spoon, a few laurel leaves, and a picture of the coffee-tree.

I. INTRODUCTION

COMMENCE with a few words about the last lesson. Remind the children that tea is an article which is used day by day in every home, although we do not eat it as we eat other things which appear on the table at meal-time.

Led them to tell that the tea which they see in the grocer's shop is prepared from the leaves of the tea-plant, that we use it to make a hot, refreshing drink, and that the leaves themselves are thrown away after the drink is made.

Prepare a cup of coffee by pouring some boiling water from the kettle on a spoonful of the dry powder. Hand it round, and let the children tell what it is. Pour off the steaming, hot liquid, and point out that here again what is left in the bottom of the cup is of no further use after the drink is made. We throw it away, just as we throw away the leaves from the teapot.

What did I put into the cup just now besides the water from the kettle? Some coffee.

What is this coffee like? It is a coarse, brown powder:

Where do we buy it? We buy it at the grocer's shop.

How does the grocer get it? He gets it by grinding coffee-beans in a mill.

What are coffee-beans? They are the seeds of a tree called the coffee-tree.

Did you ever see coffee-trees growing? No, they do not grow in our country; it is too cold. They grow in hot lands far away.

Quite right. Let us now see what we can learn about the coffee-tree.

II. THE COFFEE-TREE

Show the picture of the tree. Call special attention to the leaves. If possible have a few laurel leaves at hand, and let the children compare them with the leaves in the picture. They are very much alike in shape.

Notice the smooth surface and the bright, glossy green colour of the laurel leaves, and let the children name other leaves, such as the holly, myrtle, and ivy, which resemble them in this respect.

When do we like best to see these leaves? In the winter time.

Why? Because most plants lose their leaves before the winter comes; there are not many green leaves to be seen then.

What name do we give to plants which have green leaves all the year round? We call them evergreens; they are always green.

Compare the specimen leaves once more with those in the picture, and tell that the coffee-tree is an evergreen plant too. It bears its bright, glossy green leaves all through the year.

Point out the clusters of white flowers in the joints between the leaf-stalks and the twig from which they spring.

When the flower falls off it leaves a small, dark-red fruit, not unlike our cherry. This is the coffee-berry. It consists of a soft, juicy pulp outside, and instead of having a stone in the centre like the cherry it has two hard oval kernels,—the coffee-beans.

Hand a few of the specimen coffee-beans round the class. Let the children place two of them together, with their flat sides touching, and explain that this is the way they grow in the middle of the fruit. They are the seeds of the coffee-tree.

The tree, if left to itself, would grow from 15 to 20 feet high, but it is kept well cut back, so that it is never more than 12 feet in height. Some kinds are not allowed to grow more than 8 feet high.

Have these heights compared with those of known objects, so that the children may form a fair notion of what is meant.

Explain that the purpose of cutting plants back is to make them grow more robust and bushy. It would be well, if possible, to show the difference in this respect between two ordinary flowering plants, say geraniums. The one that had been well cut back would be sturdy and vigorous in habit, with plenty of foliage and flowers, while the other left to itself would be tall and weedy.

III. THE COFFEE-HARVEST

As the berries ripen the outer skin begins to shrivel up, and it is then time to gather them. The fruit is not plucked but shaken from the trees. Of course only the ripe ones fall, and as they fall they are caught in white sheets spread out on the ground below.

Picture an English cherry orchard when the fruit is ripe. The cherries are gathered, but only for the sake of the delicious juicy flesh; the stone in the middle of the fruit is of no use, we throw it away. It is not so with the fruit of the coffee-tree; the two beans in the middle are the best part of the berry. The juicy pulp is not wanted; it has to be got rid of in some way.

The newly-gathered berries are spread out in the sun to

dry. The sun is very powerful in those hot lands, and in a short time the soft fleshy part of the fruit dries up, and the outer skin shrinks, and shrivels, and cracks, till there is nothing but a dry husk with the hard beans inside.

These are then placed in a sort of mill, where wooden rollers are constantly revolving. The pressure of the rollers breaks up the husk into small pieces, which are winnowed away, and only the beans themselves are left behind:

Lead the children to compare this with the winnowing of the corn after harvest.

IV. ROASTING THE COFFEE-BEANS

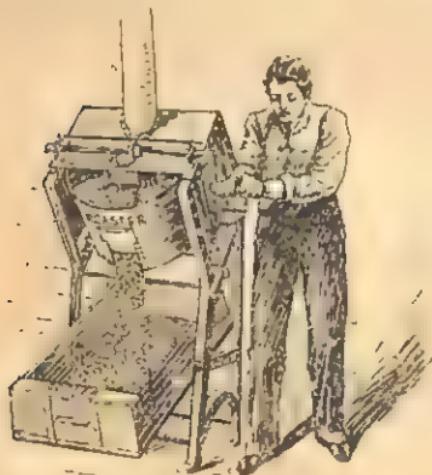
Hand some raw and roasted beans round the class in separate saucers, and lead the children themselves to tell the difference between them.

Those in one saucer have none of the smell or taste of coffee; they are raw beans just as they were gathered. The others have been roasted; the roasting brings out their flavour.

This may be made very clear by roasting a few of the raw berries in the shovel over the fire. The children will quickly detect the

familiar aroma as the roasting goes on.

Now let us see how the roasting is done to prepare the coffee for use, for of course it would never do to roast it in this way. The very greatest care must be taken to see that the beans are only roasted, not scorched and burned.



They are placed in a close iron cylinder, **something like a barrel**, which is fixed over a slow, gentle fire, in such a way that it may be **constantly turning round**. As the barrel turns round the beans inside it are kept on the move, so that the heat of the fire can act upon all of them ; they all get gently roasted, and none of them are burned.

Lesson XV

COCOA

Specimens of soluble and flaked cocoa, and chocolate, a cocoa-pod, some cocoa-beans and cocoa-nibs, and a picture of the tree will be required.

I. INTRODUCTION

PRODUCE the specimen of cocoa, and by referring to the earlier lesson lead the children to tell all they can about it in some such way as this :—

Look at this brown powder, and tell me what it is, and where it comes from. It is cocoa ; it is made from cocoa-beans.

What are cocoa-beans ? They are the **seeds of the cocoa-tree**.

Did you ever see a cocoa-tree ? No ; this tree grows **only in very hot lands**. It would not grow here.

On what part of the tree are the seeds found ? They **grow in pods**.

Quite right. Here is one of the pods, and these are the seeds, or nuts which grew inside it. They do not smell like cocoa, and if I put a piece of one of them into my mouth it would not taste like cocoa. What does this mean ? It means that they are raw beans. **They have no flavour till they are roasted.**

What other things have to be roasted to bring out their flavour ? The fresh-gathered leaves from the tea-plant and the raw coffee-beans have no flavour at first. They have to be roasted.

II. THE COCOA-TREE

Show the picture of the cocoa-tree, and lead the children themselves step by step to distinguish between this and the tree on which cocoa-nuts grow.

The cocoa-nut tree is a palm, which reaches 100 feet in height. This is a tree very much like our cherry-tree in size and shape.

Like the coffee-tree, it is an evergreen, with bright, smooth, glossy, dark-green leaves.

It bears clusters of small but very pretty flowers, which grow only on the trunk and principal branches. When the flower falls off it leaves hanging in its place a green pod, something like a small vegetable marrow or a thick cucumber in shape.

The pod grows and ripens as it hangs. When full grown it is from 7 to 9 inches long, and about 4 inches across. It changes colour, too, from green to yellow red, and purple as it ripens.

Picture the tree as it grows; it is a very beautiful tree. At all seasons of the year it has an abundance of bright, glossy, green leaves, for it is an evergreen, and new leaves are constantly budding forth. Then, too, there are always clusters of flowers on the stem and all the main branches, and as flower after flower dies, it leaves a new pod in its place. On the same tree, too, there are always pods in every stage of growth—some green, some yellow, some red, some purple. In fact ripe fruit may be gathered from the same tree at all times in the year.

III. THE POD

Produce the specimen pod.

When quite ripe the pod is a hard, tough, woody case like this, filled with seeds.

I have already told you that the flowers, and of course the pods which come after them, grow on the trunk and main branches of the tree. Depend upon it, this is not an

accident—there is a good reason for it; for if we look at the apples, pears, plums, and cherries, as they grow on our trees, we shall find them hanging from the small twigs—not growing out from the stem and principal limbs of the tree.

Lead the children to think of the size and weight of these pods. Such heavy fruits could not be supported by a mere twig. Nature never makes a mistake—she places these pods where they can hang and grow and ripen in safety.

Now let us think about the pod itself. Inside the hard woody case there are the seeds—twenty, thirty, forty, and sometimes fifty in number.

They grow close together in rows, round a central core, and are packed in a spongy, pinkish-white pulp.

A water melon or a vegetable marrow cut open would give a good conception of this, if one could be obtained for the lesson.

Each seed or nut is about the size and shape of a small bean, and is covered with a thin, brittle shell or husk.

IV. HOW THE SEEDS ARE PREPARED

Let some of these be handed round the class for inspection.

When the ripe pods are gathered they are opened, and left to lie in a heap for about two days, after which the beans are removed from the pulpy matter in which they are packed, and spread out in the sun to dry.

As they dry the thin outer husk shrivels up and becomes still more brittle, and when it cracks the brown kernel itself is seen inside.

The next step is to roast the beans. This is done in exactly the same way as coffee-beans are roasted.

Let the children themselves describe the roasting process—the teacher assisting only when necessary. Why is the cylinder made to revolve?

The roasted beans are next crushed up into small pieces, which are called coco-nibs, and as the crushing goes on the fragments of the thin outer husk are winnowed away.

All preparations of cocoa are made from these cocoa-nibs.

Specimens of cocoa-nibs, soluble cocoa, flaked cocoa, and chocolate may be shown; but it will not be necessary or advisable at this stage to give any detailed account of their preparation.

Lesson XVI

SHEEP AND COWS

Provide pictures of the sheep and the cow, and a diagram or sketch of the four stomachs of the ruminants. An actual sheep's skull would be found most useful. It may be easily prepared by boiling the flesh away from a sheep's head, after which the bones may be cleaned and polished. Of course some care is necessary in choosing a perfect specimen.

I. INTRODUCTION

COMMENCE by calling upon the children to name the different kinds of meat which they can see in the shops, and proceed as follows:—

What is beef? The **flesh of the cow**.

We have another name for the cow. What is it? We sometimes call it **an ox**.

What is the young ox called? It is called a calf.

What name do we give to its flesh when we see it hanging up in the shop? We call it veal.

What is mutton? Mutton is the **flesh of the sheep**.

What do we call the young sheep when it is alive? A lamb.

What do we call its flesh when it is killed? We call the flesh lamb too.

We will now see what we can learn about these two useful animals, the ox and the sheep.

II. HOW THEY DIFFER

Show pictures of the animals, and lead the children, step by step, to notice the points of difference between them.

1. Size.—The ox is a large, thick-set animal, almost as big as a horse, and it has short, thick, solid-looking legs, just fit to support its heavy body.

The sheep is a much smaller animal, about the size of a large dog. Its legs are slender. They have not so much weight to hold up.

2. Horns.—The ox has a short, thick neck, and a broad, deep chest; and growing out from the top of its head are a pair of smooth, pointed horns.

Elicit from the class that the sheep in the picture have no horns. Tell that most sheep are like these, but there are some sheep which have long, curling horns.

3. Covering.—Notice next the covering of the two animals.

The ox has a thick skin or hide, covered with short, coarse hair. Its tail is long, and is furnished with a thick tuft of hair at the end.

Who has seen the cow on a hot summer day, whisking its tail in all directions? Why does she do this?

Explain that the flies are very troublesome in the hot weather. They settle on her head and neck and body, and worry her. She uses her long tail with its tuft of hair to drive them off.

Now look at the sheep's coat. What is that? A thick coat of wool.

What kind of tail has the sheep? It has a very short tail.

Point out that the flies cannot get to the skin of the sheep to worry it through that thick covering of wool. The sheep does not want a long tail to whisk them off.

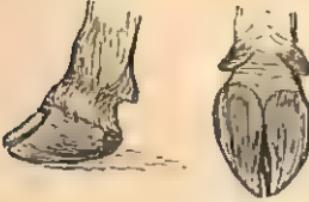
4. Milk.—Lead the children to tell that the cow gives us milk, but that we do not get milk from the sheep.

III. HOW THEY ARE LIKE EACH OTHER

1. In their Nature.—Point out in both animals the large, gentle-looking eyes, and the ears which can be raised erect in an instant. Tell that both of them are very timid, gentle creatures, and that these large eyes and

quick ears are intended to warn them if any danger approaches. Sheep are so timid that they will run away if only a little child goes near them.

2. In their Feet.—Compare the feet of the sheep and the cow in the picture. Lead the children to point out that in both animals the foot is divided by a deep cleft down the middle, which really forms two toes.



Show and explain that the inner surfaces of the two toes fit closely together, as though the foot had been split down the middle.

Notice next that each toe is encased in a hard, horny covering, which we call a hoof.

We call the foot of the cow and the sheep a cloven hoof, because it is split in two. The word **cloven** means split in two.

Look now at the feet once more. How many toes do you find in the cow's foot? Four; two large ones in front and two short ones behind.

Explain that in walking, the cow never touches the ground with these two hinder toes; and then point out that the foot of the sheep has also four toes. It is in every respect like that of the cow; the sheep, too, walks on its two front toes.

3. In their Teeth.—Show a picture of the skull of each animal. Call attention to the broad, flat-crowned teeth in the back of each jaw.

We call teeth of this kind **grinders**. They are meant to grind up the food. What kind of food do cows and sheep eat? They feed on grass.



Lead the children to discover next that in both cases there are

no teeth whatever in the front of the upper jaw. Let them tell what other animals have teeth in front. Why should the sheep and cow have none in the top jaw—only some sharp, flat teeth in the lower jaw?

Point out that in the place where the teeth would be in the upper jaw there is a hard, thick pad of gristle, but no teeth.

While they are feeding in the meadow, these animals collect up tuft after tuft of grass with their long, flexible tongue and lips. The row of sharp, cutting teeth in the lower jaw then holds the grass firmly against the hard pad in the upper jaw, and with a sharp jerk of the head the little tuft is either torn or cut off and swallowed.

This is the way in which cows and sheep feed,

4. In their Feeding.—Picture the sheep and cows feeding in a meadow.

If we watch them carefully, we shall see that they tear off the grass, tuft after tuft, and swallow it at once.

When we take a mouthful of bread and butter what are we very careful to do? We chew it well before we swallow it.

Yes; but sheep and cows do nothing of the sort. They go on tearing off and swallowing the tufts of grass, till they have got as much as they want, but they never stay to chew it. They go away and lie quietly down for a long time, and if we watch them as they lie there, we may see their jaws moving all the time, as if they were chewing something. They really are chewing.

Explain that the great difference between these animals and others is, that cows and sheep have four stomachs instead of one.

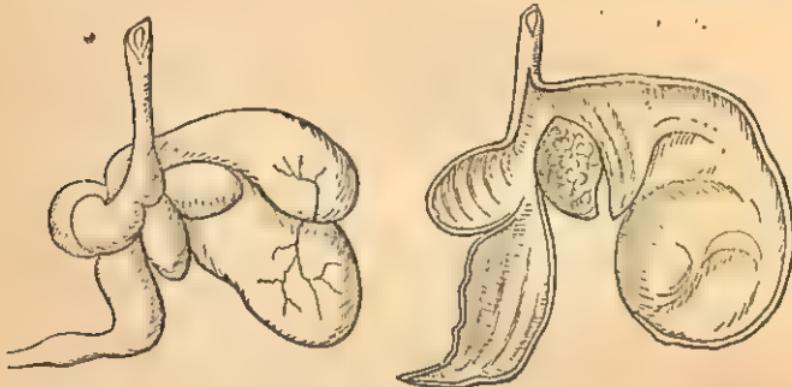
Show a good diagram of this, or sketch the arrangement on the blackboards.

The grass is swallowed without chewing into a large bag, which we call the paunch, or first stomach, and the animal goes on collecting it up and swallowing it until the paunch is full. While it lies at rest, the grass is passed from the paunch into another and smaller bag, the

second stomach, which has little hollow cells all round its sides, something like a honeycomb.

The grass collects in little **cuds** or **pellets** in these hollows, and the cuds are then passed up into the mouth again, one by one, to be chewed.

This is really what the sheep and cows are doing as they lie so quietly on the ground those broad, flat,



grinding teeth act like the mill-stones of a mill, and crush up the grass.

After being well chewed the grass is again swallowed, but it goes into another bag now—the **third stomach**; and from this it passes into another—the fourth, or **true stomach**, to be digested. This way of eating is called **chewing the cud**.

Lesson XVII

THE PIG

A picture of the pig will be required; and an actual skull, if it can be prepared, will serve much better than a picture for illustrating the animal's teeth, etc.

I. INTRODUCTION

LET us begin our lesson to-day by thinking once more about the butcher's shop. What other animal do we see

hanging in the shop besides the ox and the sheep? The pig.

What do we call the flesh of the pig? Pork.

Now think again. Is the flesh of the pig always called pork? No, some of it is bacon.

What is the difference between pork and bacon? Pork is the name for the **fresh-killed meat** which we see in the butcher's shop. **Bacon is the same meat dried.**

Where does mother go to buy bacon? She buys it at the provision shop.

What is the object of turning the fresh pork into dried meat?

Lead the children to tell that the fresh meat in the butcher's shop would not keep very long; it would soon go bad, and become unfit for food; and so elicit from them the use of salt in preserving meat.

Remind them of the lesson in the earlier stage, and assist them, if necessary, to describe the process of curing the bacon.

The pig, as soon as it is killed, is cut into two halves, down the middle of the back, and these are laid in **strong brine** till they are well salted. They are then taken out of the brine and hung up to dry in the smoke of wood fires.

When the meat is quite dried, or **cured**, it is not at all like pork, either in look or taste. We call it bacon, and it will keep for a very long time.

We call the two halves of the animal **fitches** or **sides of bacon**. The legs are cut off, and salted and cured by themselves. These we call **hams**.

The pig, you see, is a very useful animal. It supplies us with three kinds of meat—pork, bacon, and ham. Let us see now what we can learn about the animal itself.

II. HOW THE PIG FEEDS

Show the picture of the pig now, and lead the children to tell what they can of its general appearance and habits. Most people in the country keep a pig. They give it a little house to

live in, which we call a sty. Tell that the pig-sty is often a very filthy place; but that is the fault of the people, not of the pig. The pig is not naturally more filthy in his habits than any other animal.

Remind the children that sheep and cows feed on the grass in the meadows, and then tell of the greedy, gluttonous nature of the pig—always ready to eat anything, and not at all particular what it is.

If allowed to run loose in a field, the pig will get a living by eating the grass and grubbing in the earth for roots. If he finds his way into an orchard or a potato-field, he will live on the fallen fruit or the potatoes in the ground. He has a special liking for acorns and beech-nuts in the autumn, but nothing comes amiss to him when he is hungry.

People who keep pigs always have a large tub, into which they throw all the waste from the table—pieces of meat, bread, potatoes, vegetables, pot-washings, anything and everything that is waste and refuse—and it all goes to make valuable flesh at a very small cost.

Let us compare the pig with the sheep, and see what we can find out about the animal, for it lives and feeds in its own particular way, because it was intended to do so.

III. BUILD OF THE PIG

1. **The Head.**—Call attention to the long, pointed head, ending in a strong and rather broad snout.

The snout is made of hard, tough gristle, and is intended for grubbing in the ground. The nostrils are at the end of the snout, and the sense of smell is very keen.

Picture the animal in its wild state roaming through the woods and forests in search of food. It finds, by means of its keen sense of smell, the acorns, beech-nuts, and roots, although they are beneath the ground, and then with its strong snout it grubs them up. This strong snout, therefore, is

very useful, and fits the animal to live on the kind of food it likes best.

Lead the children to imagine a pig with a head like that of the sheep, and show that with such a head the animal must starve, as learn to eat different food.

The soft, movable, lips of the sheep, so well fitted for collecting up the tufts of grass, would be of no use whatever for rooting and digging in the ground.

2. Mouth and Teeth.—Notice the great mouth with its large, powerful teeth in both jaws. Besides great grinding teeth at the back, like those of the sheep, it has a row of front teeth in both jaws, and four large, sharp-pointed teeth, one on each side of them.

In the boar, that is the male animal, these four pointed teeth grow into great, curved tusks, which stand out from the sides of his mouth.

The wild boar is one of the most terrible animals of the forest, because of his great sharp tusks, which he can use with dreadful effect against his enemies.

3. Sight and Hearing.—The eyes are small and deeply set, and the ears are large and upright. The eyes of the common pig seem dull and sleepy, but in the wild state, where the animals have to be on the watch for their enemies, both sight and hearing are very sharp.

Compare them in this respect with the sheep, whose eyes are large, timid, and watchful—ready to take alarm at the least sign of danger.

4. The Body.—The body is round like a barrel, the neck very short, and the head in a line with the back. It has a short, thin tail, which is usually twisted into a curl. The skin is very hard and thick, and covered with stiff hairs, which we call bristles.

Compare the long tufted tail of the cow. What use does the cow make of her tail? Why does the pig not need such a tail? Flies cannot annoy and worry the animal, with that hard, thick skin.

5. The Legs and Feet.—The legs are short, and the feet are cloven like those of the sheep. The foot has four

toes, and the two front ones are encased in a **horny, cloven hoof**. The hinder pair are smaller, and **do not touch the ground** in walking.

Now, what did we learn about animals with cloven hoofs? They **chew the cud**.

Yes, most of them do, but the pig, although it has a cloven hoof like the sheep and the cow, **does not chew the cud**. It has only **one stomach**—not four as they have—and it chews its food **before swallowing it**.

Picture the animal feeding. It would eat and eat as long as there was anything before it, and then it would most likely roll over and doze with its little eyes almost shut. But we should not see its jaws moving in the act of chewing. Pigs chew their food, as we do, before they swallow it.

Lesson XVIII

RABBITS

A picture of a rabbit, or a stuffed specimen if it can be obtained, a chisel, and a piece of soft wood, will be required for illustration.

I. INTRODUCTION

COMMENCE once more with a few words about the different kinds of meat.

Call upon the children to distinguish between fresh and dried meat.

For fresh meat we go to the butcher; bacon and ham come from the provision shop.

Remind them of some little animals with soft, fur coats, which they often see hanging in rows in the provision shops. They are sold for food; their flesh provides us with very delicate meat. Show the picture, and ask for the name of the animal.

It is a rabbit.

Yes, this is a picture of a rabbit. Did you ever see a rabbit alive? Oh, you keep rabbits at home, do you?

But those you keep are **tame rabbits**, and live in a hutch. This is not the picture of a tame rabbit, but a wild one. **Wild rabbits** are found in the woods and fields in all parts of the country. Let us see what we can learn about these useful little animals.

II. GENERAL APPEARANCE

Produce, if possible, the stuffed specimen, and lead the children, step by step, to notice the chief points in the animal, as follows:—

1. Size, Shape, and Covering.—Elicit from them that the rabbit is about the size of the cat; that it has a long body and a small head; and like the cat has a thick, soft, warm coat of fur.

Lead them to tell that the pretty tame rabbits, which they sometimes see in hutches, are of various colours—black, white, gray, and brown—and explain that the wild rabbits are always gray, or brownish gray.

2. Eyes and Ears.—Call attention to the ears. They are long and broad, and will either stand upright or hang down. The rabbit can easily move them. Notice, too, the large bright eyes. Point out that they are placed one on each side of the face, not in front as ours are.

What is the reason for this? The rabbit is a very timid, gentle animal. It cannot fight to defend itself as cats and dogs do. It has to be very watchful to keep out of danger. Its big, wide-open ears catch the slightest sound; and with those eyes at the sides of the head it is able to see all round it at once. As soon as it is out of danger its long ears droop down on its neck; but at the least sound up they go again to listen.

3. Whiskers.—Notice next the long hairs or bristles standing out on each side of the mouth.

Do you know any other animal that has these hairs? What do we call them? Whiskers.

Tell the other name—**feelers**. All the animals which have these feelers live a great deal in the dark. These stiff

bristles enable them to feel their way about when it is too dark to see.

4. Legs and Feet.—*Elicit from the class that, as these animals cannot fight their enemies, they must run away and hide themselves, and this will show the need of strong legs for running.*

Tell that rabbits can run very fast. Call attention to the hind legs—they are much longer and stronger than the fore legs. The rabbit's running is more like leaping, for it leaps along on these strong hind legs.

As it runs it seems to bob and jump about, because its legs are not all the same length.

Picture the rabbits as they are often seen in the country fields, darting away out of sight, in leaps and bounds, the little white tails bobbing up and down as they go.

The soles of the feet are hairy; this helps them in their running. Each foot has four toes, and the toes are armed with thick, blunt claws. What use do cats and other animals make of their claws? They fight and scratch with them.

But rabbits are not fighting animals. What can they want with strong claws?

Tell that these animals use their claws for digging in the ground.

III. MOUTH, TEETH, AND FOOD

We have learnt all we can of the rabbit by looking at it. Let us now examine it a little more closely. I am going to show you its **mouth and teeth**, for they will tell us what kind of food it eats, and then we shall easily learn something about its habits.

Point out in the first place the peculiar form of the upper lip, with its long cleft dividing it into two halves, both movable.

The mouth itself is small, and the teeth are different from those of most other animals. The **four front teeth**, two in the upper and two in the lower jaw, are **long, broad, flat, and very sharp** at their edges. They are,

in fact, four sharp chisels. We often call them **chisel-teeth**.

Point these out in a good picture of the skull, or better still have a real skull prepared for illustration. There need be no difficulty in boiling the flesh from the bones and cleaning them for the purpose.

Show a chisel. Illustrate its use. It cuts off pieces of wood in slices.

Tell that the rabbit uses these four front teeth to gnaw or nibble its food in pieces. We call it a **gnawing animal** because of this. It lives on vegetable food of all kinds. It does much damage by gnawing the farmer's crops, and even the young trees in the fields.

Call attention once more to the cleft in the upper lip.

Why should the lip be split like this? Let us see.

Point out that we ourselves could not gnaw things as the rabbit does, although we also have four flat chisel-teeth in front. How is this? Our lips would be in the way; they would get cut and torn by the hard substances, and so would our mouth and tongue.

The rabbit's teeth are made for gnawing; they stand out well in front; and it is to help the animal in its work that the **upper lip is split** in two, so that the two parts may be drawn back out of the way when it is gnawing anything very hard.

Show too how the mouth itself is protected. Call attention to the **white patch** of thick, hard skin on the **tongue**, and the horny ridges which form the **roof of the mouth**. Even the **inside of each cheek** is protected by a tuft of hair. What is the reason for all this?

Leave the jaws examined for the other teeth. Notice the long space in both jaws between the chisel-teeth and the next. The rabbit has only two kinds of teeth.

In the back part of each jaw are the **grinding-teeth**. There are six of them in the upper jaw and five in the lower. They are large, square-looking teeth, with **sharp, rough, rasp-like ridges**, for the purpose of grinding the food which the chisel-teeth have cut off in slices.

Now let us notice the kind of vegetable food these animals find to eat in the woods and fields. They eat **the farmer's corn** in the corn-fields, and they nibble and gnaw his turnips and other roots. They are very fond, too, of the bark of young trees. They gnaw off the bark as far as they can reach, and in this way do much damage.

But they have another purpose to serve in gnawing the trees. Picture the cat, as we often see her, scratching with her claws on the wooden fence, the trees, and even the legs of the tables and chairs. Why does she do this?

Explain that this is her way of keeping her claws sharp and in good order. Without sharp claws she would not be able to catch the mice. Tell that the rabbits gnaw the hard trunks of the trees for the very same purpose—merely to keep their working tools in good order. Without sharp chisel-teeth to gnaw their food these animals would starve.

Lesson XIX

RABBITS—(*Continued*)

Provide a chisel; a picture of a ferret or a weasel, and another of the rabbits' burrows.

I. INTRODUCTION

INTRODUCE the new lesson by leading the class to tell all they can of the nature and general build of the animal. Be careful to show how the nature and habits are dependent on the structure.

Here we have a timid, frightened little animal, with no means of defending itself against its numerous enemies. To make up for this it has a pair of large, wide-open ears, and its eyes are placed at the sides of the face. It can easily erect its ears and turn them in any direction to catch the faintest sound; and the eyes can see readily on all sides.

In this way it gets timely warning of all danger, and

then is able to make use of its swiftness in running or rather leaping away.

It was intended to live on roots and other vegetable food, and it is provided with chisel-teeth for **nibbling or cutting away its food** in chips or slices, fit for the grinding-teeth to chew.

Lead them next to talk about the thick, warm covering of fur. Show that this is just the sort of coat to fit the animal to live in the open air. The colour of the fur, too, is just the colour of the ploughed fields over which it loves to scamper.

The claws are made for scratching and digging in the earth, and the whiskers are for the purpose of feeling its way in the dark, when the eyes are no longer of use. All these points should be deduced step by step.

II. ANOTHER LOOK AT THE TEETH

Call upon the children to describe, as far as they can, the gnawing teeth of the rabbit. They are long and flat, with a sharp edge something like a chisel. We call them chisel-teeth.

Show a carpenter's chisel, and call attention to the peculiar form of its edge.

After the carpenter has used his chisel for some time what happens to it? It becomes blunt, and will not cut.

Why is this? Because **the steel wears away** with the work.

What does the carpenter do then? He sharpens the edge of the chisel again to make it cut.

But if hard steel wears away and gets blunt, do not these chisel-teeth of the rabbit wear away with their work?

Lead the children to tell in this way how the rabbit sharpens up its teeth by gnawing the hard, woody trunks of trees; and then proceed to explain how Nature assists it.

The under part of the tooth is made of much softer substance than the front or outer part. Therefore, as the teeth are used the softer part wears away more

quickly than the hard outer part, and the edge is always kept sharp.

But even that hard steel chisel of the carpenter wears away altogether in time, and he has to get a new one. The rabbit never wants new teeth, because as fast as they are worn away at the edges they grow and are pushed up from the jaw, and so are always kept the same length.

III. RABBITS AT HOME

In all parts of the country rabbits live wild in the fields



and woods. They are very frightened, timid creatures, and like to hide away out of sight in their homes.

But their home; what is it? Rabbits make their homes **underground**.

How do they do this? They use their **strong feet and stout, blunt claws** to burrow or dig holes in the ground.

They always choose a **sandy spot**, often on the sunny side of a hill, where it is sure to be warm and dry, and

here they set to work. They dig easily in the sandy soil with their feet, and make long winding passages or **burrows** under the ground.

They live together in great numbers, and make their burrows side by side. A great many burrows close together form a **warren**.

Tell that, once in their burrows, the rabbits are safe from all such large enemies as dogs and foxes, because they make their



long winding holes only just large enough for themselves, and those big animals cannot make their way into them.

Explain that they have other enemies quite as terrible, although smaller than they themselves are. Show pictures of the **ferret** and **weasel**. These fierce little animals can easily make their way into the burrow. How do the rabbits protect themselves against them?

Tell that they always make their burrows with two or more entrances, so that if any such enemy should come in at one hole they would be able to escape by another. Remember they cannot fight.

Let us have a peep at the rabbit at home. Here at the

end of one of those long passages the mother rabbit prepares a nice, snug bed of grass, hay, or straw, and to make it still warmer and more cosy she covers this with fur from her body. This is where the tiny rabbits are born and kept safe.

But how do they get on in the dark; for, remember, it is dark in those underground passages? Their feelers serve them instead of eyes, so that they know where they are going.

Tell that they are rarely seen abroad during the day, certainly never far from their burrows; but after dusk, and in the early morning, they love to scamper over the fields. The colour of their fur, which is very like the colour of the earth, serves to hide them from their enemies, and their sharp ears and eyes tell them if any danger approaches. Picture them scampering off into the corn-fields and turnip-fields.

Why do they go there? To get food. They do much damage by gnawing the farmer's crops, and the farmer often takes his gun in the morning and evening and makes short work of the intruders.

Explain that these are the little animals we see hanging up in the provision shops. These wild rabbits are always sent to market in their skins just as they are shot.

Tell that in some places rabbits are reared for market in warrens that are made for them. Remind the children of the piles of skinned rabbits to be seen in the shops. They are called Ostend rabbits because they are sent to us from a place called Ostend. They are skinned before they are sent to market.

It will interest the children to know that the fur of these rabbits is used for making felt for hats.

Lesson XX

HARES AND RABBITS (A COMPARISON)

Pictures of a hare and a rabbit,—a hare's form,—coursing.

I. POINTS IN WHICH THEY ARE ALIKE

Show pictures of the two animals, and lead the children themselves to find points in which they resemble each other, the teacher assisting of course where they fail. Take the points, one by one, in the order given below.

1. General Appearance.—In both animals the body, head, and ears have the same general shape; the eyes are large, and are placed at the sides of the head; the hind legs are much longer and stronger than the fore legs; the feet are soft, hairy paws with four toes, and each toe is armed with a strong, blunt claw; and the covering in each case is a coat of fur.

The pictures, you see, have told us that the two animals are alike in shape and general appearance. But I want you to look again, and tell me whether they are alike in their nature. The pictures will tell you that too. Yes, they are both timid animals, and unable to fight to defend themselves.

How did you find that out? Their ears and eyes tell us that.

Why should timid animals have great ears? They are very watchful, always on the alert. These long, wide-open ears are able to catch the faintest sound, and so give the animal warning immediately any danger approaches.

Picture these animals in the fields in the act of listening. They can turn their ears backward or forwards, or from side to side, to catch the sound from any direction. The hare is even more watchful and alert than the rabbit. It is a very difficult matter to get near a hare.

How did the eyes help you to tell the nature of the animal? The large bright eyes placed at the sides of

the face are to enable the animal to see all round it. All timid, defenceless animals have eyes like these.

Now that you know the nature of the hare, you can tell me why it is provided with those long hind legs. As it cannot fight to defend itself it has to depend upon its legs to get away from its enemies.

Tell that all timid, defenceless animals are very **swift of foot**. Their sharp ears and eyes give them timely warning of danger, and their long legs then carry them away at tremendous speed. The hare is one of the swiftest of all animals.

2. Mouth and Teeth.—Now let us turn to the pictures once more. What do you notice about the mouth in each animal? The upper lip is **split in two**.

What is the object of this split lip? The two parts can be drawn aside, so that the **teeth may project** in front of the mouth.

What kind of teeth are they? They are **flat, chisel-teeth**.

Have the teeth pointed out in the picture.

Why should these chisel-teeth project in front of the mouth? They are meant for **gnawing**. The animals could not gnaw with lips like ours.

What do they gnaw? They gnaw the food on which they live.

What kind of food do they live on? Vegetable food.

What name do we give to all these animals? We call them **gnawing animals**.

Then as the hare has chisel-teeth and a split lip, it is a gnawing animal like the rabbit.

Remind the children that the flesh of both these animals is used for food. We often see hares as well as rabbits hanging up in the provision shops. How should we tell one from the other?

II. POINTS IN WHICH THEY DIFFER

1. Size.—*Explain that if the two animals were placed side by side, the first thing to strike us would be the difference in size.*

The hare is **larger than the rabbit**. The hind legs are much longer and stronger ; the ears, too, are bigger.

2. The Fur.—The fur of the hare is **soft and curly**, almost like wool ; the rabbit's fur is smooth, and not in the least curly. The colour, too, is different. The back and sides of the hare are **reddish brown mingled with black**, the under part of the body is almost white. The rabbit's fur, you know, is **a grayish brown**.

Tell that we may often see **white hares** hanging in the shops. These come from cold lands a long way off. Explain that in the long, cold winters there, the fur of these and many other wild animals turns white, just like the snow which covers the ground.

3. Habits.—Remind the children of the gregarious nature of the rabbit. N.B.—This does not mean that the word **gregarious** is to be used. Let them describe its burrowing habits, and its life underground and above—immense numbers living together in one warren.

Tell that the hare is **not fond of company**, and is **not a burrowing animal**. It does not live underground. It chooses a quiet spot, where the grass and ferns are thickest, and there it makes a **slight hollow**—a sort of nest—just big enough for itself and its mate. This is its home, and this is where its little ones are born—three, four, or five at a birth. We call this nest the “**form**” because it takes the **shape or form of the animal itself**.

Remind the children that the hare is much worse off than the rabbit, for it has no underground burrow into which it can rush for safety from its enemies ; and so lead them to see the need for greater speed in running. **The hare runs very much faster than the rabbit.**

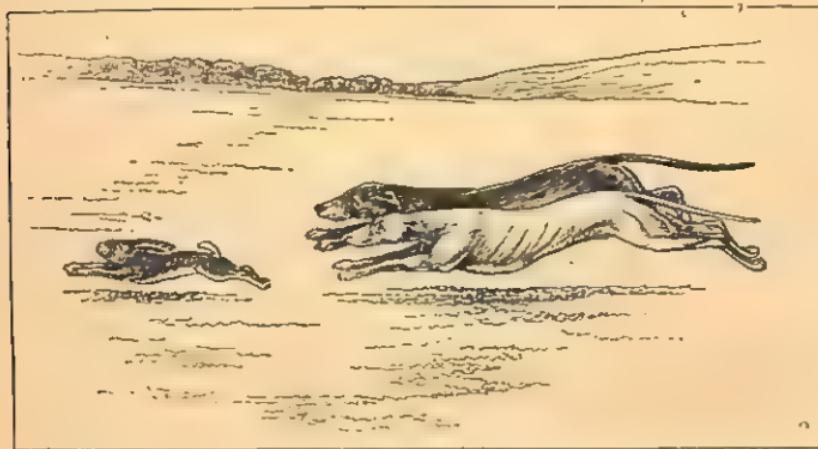
The hare is hunted by very swift dogs called **greyhounds**.

These dogs chase their prey by keeping it in sight, and at last run it down exhausted. It is really a race between the hare and the hounds, but the hare is running for its life. We call this sort of hunting **hare-coursing**.

Tell of the clever trick of the hare in dodging the dogs by

doubling on them. In its headlong speed it manages to turn all of a sudden, and run in another direction. The dogs cannot do this so well, and they dash on in the same course for some time before they can turn. This gives the hare a fresh start, and often saves its life.

Because hares are chased in this way for sport we call them **game**. Rabbits are not reckoned as game.



The flesh of the hare is **dark in colour**, and **very rich**. The rabbit's flesh is lighter and more delicate.

Lesson XXI

POULTRY

Provide pictures of poultry birds, and an actual foot and bill of a hen and a duck if they can be obtained. Two sheets of white notepaper and some oil will also be required.

I. INTRODUCTION

COMMENCE with a few words about another kind of shop, in which numbers of large birds are to be seen. Call upon the children to tell the names of these birds—ducks, geese, fowls, turkeys, and pigeons.

Ask for the one common name—**poultry**. Tell that these

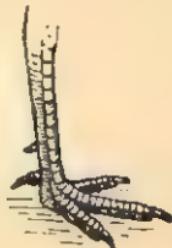
poultry birds are sold in the shops because their flesh provides us with very rich and delicious meat.

Remind the children that these are all tame birds. People rear them and take care of them near their own homes. Tell that other birds may be seen hanging in the shops—partridges, pheasants, grouse; but these are wild birds that live in the woods and fields. They are called game; they are killed for sport.

II. THE HEN AND DUCK COMPARED

1. The Feet.—Show pictures of the poultry birds. Point out that some of them are in the water, some not. Let the children name them.

Those ducks and geese seem quite at home in the



water. Would the others be as happy there as they are? No; fowls, pigeons, and turkeys cannot swim; they do not like the water. **Ducks and geese** are water-birds; they spend most of their time in the water.

How is it that some birds can swim and others not? Birds that swim have **webbed feet**.

What do you mean by webbed feet?

Lead the children to tell, as far as they can from their earlier lesson, the nature of the webbed foot. Produce the foot of the hen and the duck, and let the children handle and examine them for themselves. The foot of the duck is webbed. It is this web between the toes which enables ducks and all water-birds to swim. They are quite at their ease in the water. The hen's foot is not webbed. That is why she cannot swim.

Compare the legs of the ducks and fowls. The duck's legs

are very short. They make splendid paddles, but they are not good for walking or running. The duck waddles—all the water-birds are awkward out of the water. Notice the difference in the legs of the fowl. They are long; the body is raised up high above the ground. These birds walk and run well. What a proud, majestic strut the cock has!

Why should ducks and geese be provided with feet for swimming? They find most of their food in the water.

What food do they like best? The worms and grubs that live in the mud at the bottom of the ponds.

Where do fowls, pigeons, and turkeys find their food? They scratch it up out of the ground with their feet. We call them scratchers.

Call attention to the hen's foot once more. All the toes have short, blunt claws. It has three strong-looking toes in front, and a smaller one behind. Tell that all these scratchers have long legs and strong toes with blunt claws like these. Picture the duck trying to scratch in the ground with her feet. These water-birds could never get their living by scratching.

2. The Bill.—Produce the duck's bill, and let the children examine and describe it. Point out the fringes at the sides of the bill and along the edge of the tongue.

These water-birds use their broad, flat bills as shovels. They dive down to the bottom of the pond, and shovel up the mud with them. They don't want the mud, but they want the grubs and worms that are in it. When they come up again they strain out all the mud and water through those side fringes, but their prey is caught as in a trap.

Now show the beak of the hen. Notice that it is short, horny, sharp-pointed, and strong. Remind the children that these scratching birds are as fond of worms and grubs as the duck is, but that they find them in the ground, not in the water. This sharp, strong beak is to pick up the food which the toes scratch out of the ground. The broad, flat bill of the duck could not do this work; and the hen's short pointed beak would be useless in the water.

3. The Feathers.—Remind the children that these water-birds must go to the water in the cold weather as well as in the hot summer; they go for their food. Tell that fowls, pigeons, and turkeys, even if they could swim, would never live in the cold water. The cold would kill them.

How is it that these water-birds do not feel the cold?

Show, if possible, an actual duck either alive or dead. Call attention to the down. Tell that this forms a thick, warm, close-fitting under-jacket next to the skin, in addition to the usual clothing of feathers.

These water-birds are all provided with an under-coat of down which keeps out the cold; but fowls, pigeons, and turkeys have only the one covering of feathers.

Who has ever noticed the fowls on a rainy day? How do they look then? They look wet, draggled, and miserable.

Yes, they look miserable because they are wet with the rain. But think of the ducks swimming about in the pond. They are in the water itself, and yet they do not look miserable.

Picture them waddling up on the bank after swimming and diving about in the water for a long time. They scarcely seem to have wetted their feathers in the least. How is this? Let us see.

Take two sheets of paper. Smear one of them all over with oil, and then pour some water on each. Call attention to the result. The water runs off the oiled paper at once; it will not settle on it. The other paper is soaked through very quickly.

Tell that ducks and all other water-birds are able to keep their feathers dry because they oil them well, so that the water will not settle on them, or soak through them.

But how do these birds get the oil to grease their feathers? I will tell you. Perhaps you have seen a duck pecking with its bill at the roots of its feathers. It is busy getting the oil then. In the skin all over its body there are tiny little bags filled with oil; and the duck, by pecking with its bill in that way, is able to break these bags, so that the oil in them flows out over its

feathers. There are none of these oil bags in the skin of the fowl, the pigeon, or the turkey. These birds cannot grease their feathers. That is why they look so wretched in the rain. What would they look like if they were put into the pond with the ducks?

III. HOW THEY FEED WITHOUT TEETH

Picture the fowls running up to be fed in the morning. How quickly their beaks go to work in picking up the corn which is scattered on the ground for them! In a very short time it is all gone. They swallow it just as it is.

Do you remember any other animals that swallow their food at once without waiting to chew it? Cows and sheep.

What do they do when they have swallowed enough? They bring it up again into their mouths to chew it.

These birds cannot do that because **they have no teeth in their mouths.**

There is no need to do it, for **their teeth are in their stomachs.**

Let me tell you all about it.

Explain that the corn and other food passes down, as it is swallowed, into a sort of bag called **the crop or the craw.** Sketch the arrangement on the blackboard, or show in a picture. The food, after remaining in the crop long enough to get thoroughly moistened and softened, is passed on into two other bags or stomachs, one by one. The last of these is called **the gizzard.** It is a very thick, strong bag, and it is lined inside with tough, hard skin.

Describe the habit these birds have of picking up stones and swallowing them. These stones pass down into the gizzard with the food. There is always a heap of rough stones in the gizzard. **They are the teeth I spoke of. They grind up the food in the gizzard, just as the teeth of other animals grind up the food in their mouths.**

Why is the food kept in the crop to get moistened before it is sent on to the gizzard?

Lesson XXII

EGGS

Place on^o the table a hen's egg, some grains of corn, and a cup.

I. INTRODUCTION

Show the hen's egg, and proceed by means of a few carefully chosen questions to elicit from the children all they can tell about it. Of course the questions must be limited to the simple teaching of the lesson in the earlier stage.

In this way lead them first to describe the shell—**hard and firm** to the touch, yet so **brittle** that it breaks easily with a smart tap—**round**, although not with the roundness of a ball, but **egg-shaped**. Let them next deal with the inside—the **yolk**, a yellow ball in the centre, surrounded by some liquid that looks clear like water and feels very sticky if we touch it. What happens to this clear liquid if we put it into boiling water? What name do we give to it because of this?

Lastly, lead them to tell that not only the hen, but **birds of all kinds**, lay eggs; and that they **hatch** the eggs by sitting on them and keeping them warm.

II. AN EGG AND A GRAIN OF CORN

I have here some grains of corn: I want you to tell me something about them. In the first place, what are they? They are the **seeds of the corn-plant**.

What happens to them when we put them into the ground? They grow up into new corn-plants.

Look at the rounded end at the bottom of each grain, and tell me what you see? A **small, oval spot**.

Here are some more grains which have already begun to grow on this piece of damp flannel. If you look you will see that the young shoots in each of them are **sprouting out** from the little oval spot. Why is this? Underneath that spot in every grain of corn there is a tiny

corn-plant waiting to grow. We call it the **germ**. These young shoots come from the germ.

But that germ could not grow without food, and there is no food for it in the flannel. How has it been able to find food? The food is stored up **in the grain itself**.

Remind the children that the germ takes up very little room in the grain; it is quite covered by that little scar. All the rest of the grain is nothing but a store of food laid up to feed the tiny plant till it has grown big and strong enough to seek its own proper food from the soil in which it grows.

Break the egg carefully in a cup, so as not to injure the yolk, and proceed to examine it. Point out **the little round spot** on the surface of the yolk. Tell that this is **the germ of the future chicken**. Show that, like the germ of the plant in the seed, it takes up very little room, and so lead on to the fact that all the rest of the egg is simply a store of food, laid up to feed the little thing, till it has grown big enough and strong enough to begin life as a real chicken.

Explain that this is equally true of all seeds and all eggs, so that **the egg of the animal** is in this respect exactly like the seed of the plant.

III. HATCHING

Think of the wild birds of our woods and fields. Where do they lay their eggs? They lay them in a **nest** which they build for themselves.

Tell that different birds build **different kinds of nests**, and place them **in different situations**. Some are very beautiful, others are roughly made; but all are formed **something like a basin**. Why? To prevent the eggs from rolling out. A whisp of straw is quite good enough for our common hen; but she hollows out her nest to save the eggs from rolling away.

It might be well here to correct the common notion which children have that bird build their nests as homes for themselves. Let it be clearly understood that the sole purpose of the nest is to hold the eggs till they are hatched, and to give a snug

resting place to the young ones till they are able to fly. After this the nest is deserted, and the birds, old and young, perch on the branches of the trees in all weathers.

Now let us think about the work of hatching the eggs. Our common hen has to sit patiently on her eggs for **twenty-one days**, during which time the heat and moisture from her body cause the tiny germ to grow, and at last, when it is big and strong enough, it makes its way out of the shell as a real chicken.

We have seen how the little thing lives all this time on the food-supply laid up inside the shell; but there is only just enough food to last it for those three weeks. When it is ready to leave the shell **every morsel of that food is gone**.

Remind the children that, like all animals, the little chick inside the shell wants something else besides food to keep it alive.

Picture to yourselves, if you can, some little animal shut up close in a wooden box just big enough to hold it. What would happen? It would die.

Why would it die? It would die for want of air.

The little chick inside the shell must have air like every other animal. It could not live without air. Let us see how it gets air shut up close as it is.

Explain that this is provided for by the nature of the shell. It feels hard and smooth to the touch, but it is really very porous, and air is able to pass in and out through the pores in the shell.

There is something else very wonderful about the shell of the egg. It is so brittle that it will easily break with a sharp tap, and yet it is strong enough to bear a good deal of pressure without breaking.

Explain that this is partly due to the shape of the egg. Tell that although the hen is a large, heavy bird, she very rarely breaks any of her eggs in getting in and out of the nest, because they are strong enough to bear her weight if she treads upon them.

Picture the little chick on just last day when it is ready to come out of its shell. It must find its own way out. Tell how it does this by pecking against the shell with its beak.

The shell is so brittle that it will not stand this tapping, and it cracks in all directions and sets the little thing free. What would happen if the shell were tough instead of brittle?

Lesson XXIII

FISH

Articles required : a fresh herring, some live fish in a bowl of water, a test-tube, a jug of water, and the spirit lamp or the Bunsen burner.

I. INTRODUCTION

COMMENCE with a brief recapitulation of the lesson in the earlier stage, so as to elicit from the class that the fish they see in the shops provide us with another kind of animal food.

Lead them to give their reasons for calling a fish an animal. It lives, and grows, and moves about, it requires food to keep it alive and to make it grow.

Remind them that this kind of animal is fitted to live, and feed, and move about in the water, where other animals, such as sheep, cows, pigs, and birds could not live. Fishes live all their lives entirely in the water ; they could not live out of it.

Explain that we are now going to learn how it is that fishes are able to live in the water ; how they breathe ; how they move about without legs or wings ; how they feed, and so on.

II. HOW FISHES BREATHE

1. We breathe Air.—Instruct each of the children to place one hand on her chest and take a long, deep breath, following the example of the teacher. Repeat the process two or three times, so that all may note carefully what happens, and then call upon the children to explain :

What are we doing now ? We are taking in air.

Where does the air come from ? It is all round us everywhere.

How do we know we are taking it in ? We can feel it rush in at our mouth and nostrils. We can feel our chest heave as it gets full of air.

What are we doing now? We are sending the air out again.

Explain that this is what we call breathing. We could not live many minutes without breathing. We must be constantly taking in fresh air, and giving it out again after we have used it. We breathe, in this way, even when we are asleep. If we could not get air to breathe we should choke or suffocate.

Tell that the air we take in at our mouth and nostrils passes down into the lungs. Show the position of the lungs, and tell that cows, pigs, horses, and birds have lungs like ours, and breathe just as we do.

2. Fishes breathe the Air.—We and all the animals around us live and move about at the bottom of a great ocean of air. Fishes live and move about in the great ocean of water. But fishes are animals, and require air to breathe. They could not live without breathing any more than we ourselves could. But how can a fish breathe air while it is living and moving about in the water?

Tell that the water itself contains air. Refer briefly to what has already been taught as to the solvent powers of water. Tell that water sucks in and dissolves air. The water of the sea, the rivers, and the ponds is always absorbing air in this way.

Point out the bubbles in a tumbler of water that has been standing for some time. Tell that these are bubbles of air; there is always some amount of air in water.

The fish lives by robbing the water of some of this air every time it breathes.

Boil a little water in a test-tube, and call attention to the bubbles which rise upwards to the surface as the boiling goes on. Tell that we might easily drive all the air out of a quantity of water by boiling; and if then (after letting it cool) we put a living fish into it, the fish would die at once. Explain that the fish would die for want of air, because, although it lives in water, it breathes the air that is in the water, and not the water itself.

A cow, a rabbit, a hen—even a strong man—would die

if held under water. A fish dies directly it is taken out of the water. Yet both die from the same cause—both are suffocated. **The one cannot breathe in the water, the other cannot breathe out of it.**

Hence the first thing to puzzle us with regard to a fish is how it can live and breathe in the water.

3. The Gills of a Fish.—*Produce the herring and proceed to examine it.*

Now look at these long slits or openings on either side of the head, just behind the jaws. Watch, while I lift this one up, and tell me what you see underneath it.

Point out the red, fringe-like folds. Tell that these are the gills. Why are they red? They are filled with red blood.

Explain that the fish has no lungs such as we have—that, in fact, the gills are the lungs of the fish. The fish breathes, and takes in air from the water with these gills.

Show, if possible, a living fish of some sort—say a goldfish in a glass bowl. Call attention to the fact that it is constantly opening and shutting its mouth as if it were drinking. Explain that the fish is not really drinking—that it is not taking in water and swallowing it as we do when we drink. It takes the water into its mouth, but only to pass it backwards over its gills, and so out again through the slits at the sides.

Now why is this always going on? Every time the fish takes in a mouthful of water and pours it over its gills, the gills themselves suck in as much of the air as they can get from the water. Our lungs could not do that, but this is the way all fishes breathe. **The gills are able to breathe in the water.**

I. How FISHES FEED

Fishes, as a rule, feed on one another, and hunt their prey through the water as the lion, tiger, and other fierce beasts hunt theirs on the land. They almost all,

from the largest to the smallest, prey upon and devour each other. Let us examine our fish and try to find out how it goes about its water-hunting.

Open the mouth of the fish, and show that it is well provided with teeth. Show that the teeth are numerous but very small; they are simply little sharp spikes, and they all point backwards towards the throat.

Fishes have no teeth for chewing. These small pointed teeth are meant for **seizing the prey**, and holding it fast, because, as the fish has no chewing teeth, it must **swallow its prey whole**, without waiting to chew it.

IV. FISHES AND THEIR YOUNG

Fishes are produced from eggs.

Open the herring (first see that it has a hard roe). Take out the roe, and tell that each little grain of the roe is a tiny egg, which might have produced a young fish.

What an immense number of eggs from one single fish! The eggs, after they are deposited in the water by the parent fish, are called **spawn**, and the spawn forms the favourite food of many water animals. Even the tiny young fishes that come from the spawn of one kind **feed on the eggs laid by others**. Then, too, these same young fry (as the little fishes are called) **form the chief food of all others** that are large enough to prey upon them.

This explains why one single fish is made to lay such an immense number of eggs.

Tell that the eggs of the cod float on the surface of the sea till the heat of the sun hatches them, while those of the herring sink to the bottom of the shallow waters in which they are laid, and there stick to the rocks and sea-weed.

Certain fishes, too, that properly belong to the sea, always swim up the rivers to lay their eggs in some shallow place in the fresh water. The smelt, salmon, and trout are members of this class.

Lesson XXIV

MORE ABOUT FISHES

The teacher will require a smooth piece of wood and a piece of fur or wool, a bowl of water, a fresh herring, a small wooden wedge, and pictures of the various fishes named in the lesson.

I. INTRODUCTION

COMMENCE by referring the children to the last lesson. Lead them to compare their own breathing with that of a fish. Remind them that, as we live in an ocean of air, we can take in plenty of it every time we breathe. Fishes can only take in a very small quantity of air from the water in which they live.

Elicit from the class that the body of a rabbit, a sheep, or a bird always feels warm, and so do our own bodies. Tell that it is the air which we and all lung-breathing animals breathe into our lungs that warms the blood and the body.

Fishes take in so little air by their gill-breathing that it is not enough to warm their blood. **The body of a fish is always cold.** We call fishes **cold-blooded animals.**

II. FISHES AND THEIR COVERING

As fishes have no warmth in their bodies to keep in, they have no need of thick, warm clothing like that of the rabbit, the sheep, or the bird.

But there is another reason why fur, wool, or feathers would not be at all a good covering for a fish. Try and find out what I mean.

Take a smooth piece of wool, and let one of the girls move it about in a bowl of water. She does it quite easily. Now cover it with wool or fur, and let her try again. It is not so easy to force the stick through the water now, because the thick, woolly covering resists the water.

Now tell me why wool, fur, or feathers would not make a good covering for the fish. Because they would interfere with the movements of the fish in the water.

Produce the herring once more, and call attention to its shiny, silvery-looking coat. Take up some of the loose scales on the tip of the finger, and let the children examine them.

This coat is made up of a multitude of these little round scales, which overlap one another, and are firmly fixed in the skin in front. The body of the fish is really covered up in a close-fitting coat of mail.

Run the finger along the fish from head to tail. Its coat is very smooth. Rub it in the opposite direction and the scales ruffle up. Point out that, as the fish swims about, the water itself presses this scaly coat closer and closer to its body, and this helps it in its movements.

Let one of the children take the fish in her hands and describe its slimy, slippery feel. Tell that fishes are able to send out and pour over their bodies a sort of slimy oil, which also helps them much in their gliding movements through the water.

III. HOW THE FISH MOVES

1. **The shape of the Body.**—Take a small wedge of wood, and let one of the children force it through the water, first with the base foremost, then the thin edge. Which end moves with the greatest ease through the water, and why? The sharp edge cleaves or cuts the water.

Now call attention to the herring once more to illustrate the typical form of a fish.

The body, big in the middle, tapers to a sharp point both ways. It is like a pair of wedges joined together at their bases, except that all sharp corners are nicely rounded off. The herring's body is just the shape to enable it to cleave its way through the water with the greatest possible ease.

Tell that most fishes have something of this shape, although

there are others with very curious shapes—some flat, some long and thin, some round like a great ball.

2. The Fins.—We have seen that the fish is assisted in its movements by the shape of its body and also by the nature of its covering. We must now find out how it is that a fish can travel through the water at all. Let us examine our herring once more.

Point out the feather-like fins and their position. Notice first a pair, one on each breast, just behind the gills. These are the breast-fins. Then there are another pair, on the under part of the body, near the middle. These are the belly-fins.

Tell that these four answer to the **four limbs** of the land animals.

In most fishes there is also a large fin **on the back**, and one more under the body **near the tail**.

The largest and most important one of all is the **broad, upright fin** at the end of the body—that which we generally call **the tail**. Its proper name is **the tail-fin**. Let us see why we call this last one the most important of all of them.

Describe the manner in which a boatman propels his boat by means of a single oar at the stern.

The tail-fin is to the fish what the oar is to the boat. It does all the work of pushing the fish through the water. The other fins are useful **to balance** the fish and **guide it** in its movements.

Point out that the fins of the herring are soft. Tell that most fishes have soft fins of this kind; but the fins of the mackerel have sharp, prickly spines, and so have those of the little stickleback and the perch.

IV. THE FUNNY FLAT FISH

Show pictures of some of the flat fish, or better still an actual fish—a **plaice** if it can be obtained. Point out that **one side of the fish is brown, the other white**. Tell that these are not, as one might suppose, the top and bottom, but **the two sides**

of the fish. They are more flattened than the sides of the herring, that is all.

Tell that the home of these flat fish is **on the sand at the bottom of the sea.**

They have many hungry enemies among the bigger fishes, which are always on the look-out for them. This is why they lie on the bottom of the sea. They lie **on their white side, and the brown upper side of their body is just like the sandy bottom itself.**

Point out the curious fact that the two eyes are **on the same**



side of the head—the brown side. One of them seems in some strange way to have become forced out of its position. Show that if the eyes were on both sides of the head as those of other animals are, one of them would be buried in the sand and become useless. Instead of that, **both are on the brown, upper side of the head, and the fish is able to see all round it.**

Tell that, more curious than all, **this was not so at first.** The eyes of the very young plaice are on different sides of the head like those of other fishes. One of them becomes actually forced out of its position gradually, by the efforts of the fish

to see all round it, from its place at the bottom of the sea, half buried in the sand.

Call attention to the **broad fringe of fin along the edges of the body**. Tell that, of course, the fish uses these fins as other fishes use theirs; but it does something more with them than that.

When the timid plaice sees one of those hungry enemies coming along it lies still where it is on the sand, except that it begins to wave those side fringes up and down very rapidly. This throws up the sand all round, and as it falls again it **covers the fish up**, so that its enemy cannot find it.

It would make the thing very graphic to the class if the plaice were laid on the table and some sand of the same colour were spread thickly all round it. Show how the deception is still further increased by the larger, brighter-coloured particles of sand here and there, which answer to the red spots on the fish.

Call upon the class to give the names of the other flat fish.

Lesson XXV

SHRIMPS, CRABS, AND LOBSTERS

Actual specimens, or failing them, pictures must be provided.

I. INTRODUCTION

Show the specimens or (if these cannot be obtained) pictures of the animals, and proceed as usual with a brief recapitulation of the lesson in the earlier stage.

Elicit from the class that shrimps, crabs, and lobsters live in the sea, but are not fishes. All fishes have a bony skeleton, but these animals have soft bodies without any bones at all.

We might call them the crusty family. Why?

Then again they are often called the jointed family. Why?

What is the purpose of all these joints in the shell coat ?

Why are the separate pieces jointed together by tough skin ?

Once more, if we count their legs, we might give them another name. How many legs have they ?

Point out that in each case there are four pairs of these long, jointed legs for walking, and a bigger, stronger pair of claws or nippers in front for seizing the prey.

Lead the children next to describe the casting of the shell which takes place from time to time as the creature grows, and also the wonderful way in which new claws sprout and grow, should the original ones be broken off.

Tell that crabs and lobsters are terrible fighters. They fight not only with other creatures of the sea, but with one another. They often lose their claws in fighting, but new ones at once begin to sprout and grow in their place. It is no uncommon thing to see a lobster in the fishmonger's shop with one claw smaller than the other. What does that tell us ?

In the shops, too, we may often see lobsters—some with a bluish black or a dark bottle-green shell, and others bright red. What does this mean ?

Elicit that shrimps and crabs change colour, too, when they are boiled.

Picture the shrimp in the shallow, sandy pools on the seashore, where it lives. That greenish gray coat is so much like the water in colour, that it is very difficult to see the little creature. This is its protection against its many enemies.

Tell of its habit of burrowing in the loose sand to hide itself. As it does this it throws up the sand all round. What other creature acts in much the same way ?

II. THE JOINTED BODY

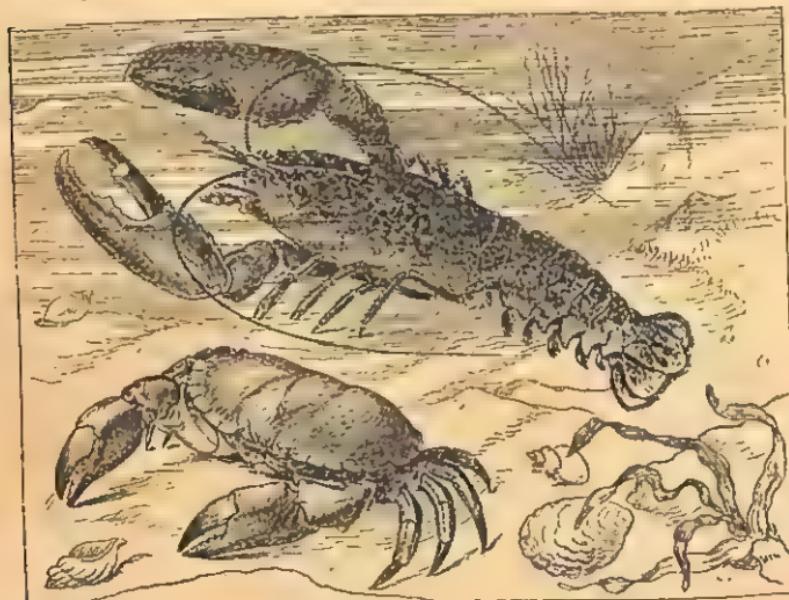
Shrimps, crabs, and lobsters are all jointed animals. The shell coat which covers their bodies is in each of them made up of a number of rings, jointed together, as we said, by tough skin, so that they may move easily.

But in the full-grown shell of the crab these rings can-

not be seen because the parts have grown together, so as to form a sort of box or case.

Show the crab, and let the children see that it is so, and then produce the lobster, and show the difference. Point out the different plates overlapping each other, and show that the body may be bent or straightened easily even now. How flexible it must have been when the animal was alive!

I want you to help me to examine this shell coat, and as



the shrimp is very much like the lobster, I will hand a few shrimps round, so that you may all see for yourselves.

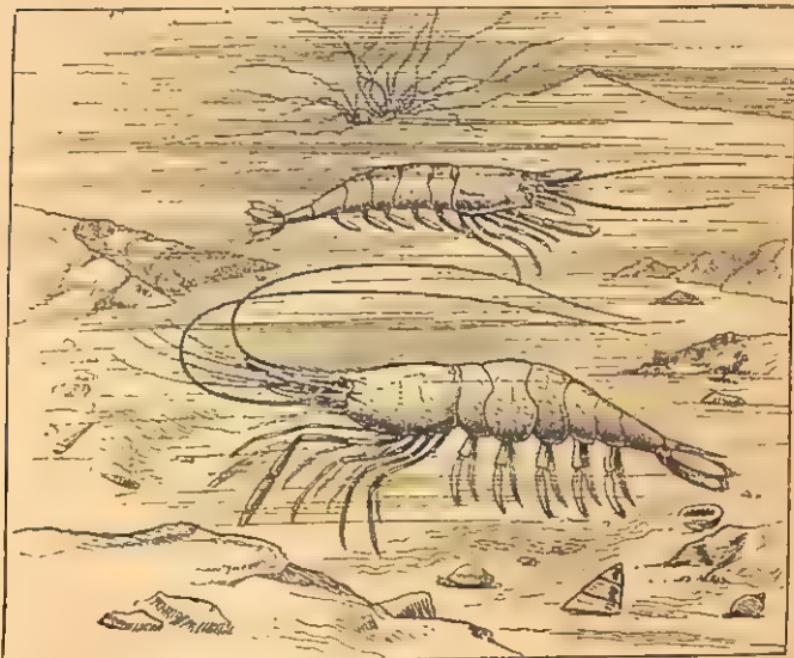
1. The Head.—First of all pull off the head, as you do when you have shrimps for tea. We will examine that first.

Notice that the head is as big as all the rest of the body. Ask the children now to look for the **five pairs of long-jointed legs**. Of course they will begin to examine the hinder part of the shrimp, which has been laid aside. Tell them that we are at present examining only the part which they have in their hand, and so lead up to the surprise that the five pairs of

legs are all joined to the head of the animal, and not to its body.

Compare the shrimp and lobster in this respect, and then show the difference in the case of the crab.

Point to the long feelers which stretch out in front of the head of the shrimp, and tell their use in helping the little



SHRIMP AND PRAWN.

creatures to feel their way where they cannot see. Show that the crab and lobster have feelers too, but the crab's feelers are short.

This will lead to the eyes. Point out the two black dots at the ends of the short stalks, close by the feelers. These are the eyes. The eyes stand out well on those eye-stalks to enable the creatures to see on all sides of them. They are the same in the crab and the lobster.

Tell that in all these creatures the mouth is formed of several pairs of strong, chewing jaws, but that they

move sideways, and not up and down as ours do. They would be best shown, of course, in the lobster.

2. The Body.—Point out that in the shrimp, as well as in the lobster, the coat consists of distinct plates of shell, one overlapping the other. Call attention to the little flat swimming paddles joined to these plates on the under side of the body—one pair to each plate. The body in each case, too, ends in a broad, flat tail.

Notice that the crab has no swimming paddles. Indeed, although it is like the lobster and the shrimp in most other respects, its body is altogether different.

Shrimps and lobsters swim as well as walk; they use their tail and paddles for swimming, and their long legs for walking. Crabs can only walk or crawl. If a small live crab could be obtained, it would amuse and instruct the children to see its awkward sideway movements.

III. THEY LAY EGGS

Shrimps, crabs, and lobsters are produced from eggs.

Remind the children that fishes too lay eggs, but they deposit their eggs in the water. Tell that these creatures carry their eggs about with them till they are hatched. They stick to the swimming paddles on the under side of the body in masses, as if they were glued there. Point out the eggs in the shrimp, and in the lobster, if it be a hen. Tell that the crab carries its eggs about glued to its tail. At first sight the crab seems to have no tail of any kind, because it is bent under the body as a sort of flap. Raise the flap and show that it is really the tail of the animal.

The young of these creatures are not in any way like the parents. They undergo many changes as they grow, shedding their shell from time to time, and at last, when they reach their full size, they become like their parents in form.

IV. THEY BREATHE THROUGH GILLS

Tell that shrimps, crabs, and lobsters breathe through

gills like fishes. Open the crab, and point out the gills, which lie in pairs just beneath the shell. They have a leaden-coloured appearance when boiled, and are commonly known as the dead flesh.

In the shrimp and lobster the gills are situated in the under part of the head, just near the legs. But in these animals not only the gills but the heart and stomach too are lodged in the head.

Lesson XXVI

GARDEN VEGETABLES

The teacher should be provided with a potato, and if possible with one or two growing out at the eyes, a picture of the growing plant, a jug of water, a rasp, a basin, and a knife.

I. INTRODUCTION

Commence by calling upon the children to enumerate the different kinds of vegetables to be seen in the green-grocer's shop, e.g. potatoes, cabbages, carrots, turnips, parsnips, onions, lettuces, peas, beans, celery, radishes, water-cress, and so on. Assist, of course, if necessary, and make a list on the blackboard of the vegetables named.

Elicit from the class that all these vegetables come from plants which grow in the garden. Tell that this is why we speak of them as **garden vegetables**.

Lead the children to tell that plants have several distinct parts, and that we do not use the same part of every plant for our vegetable food.

Which of the vegetables you have named come from the root? Carrots, parsnips, turnips, and radishes.

What kind of roots would you call them? **Fleshy roots.**

Why? Because they are **thick and solid**. Most roots are made up of long threads or strings.

Why did you not put the potato among the roots?

The potato is not a root. It is part of the stem which grows under the ground.

How do we know that? Because the potato has **eyes** or **buds**, and we never find buds on real roots.

Now tell me which of our garden vegetables is the stem of a plant. The onion. It is **the bottom of the stem swollen very big.**

What do we call this swollen part of the stem? A **bulb.**

Follow on in a similar way, so as to lead the children to tell that cabbages, lettuces, and water-cress are the leaves, celery the leaf-stalk, and peas and beans the seeds of the plants on which they grow.

Having in this way run over the ground covered by the simple teaching of the earlier stage, tell that we are now going to learn something more about these vegetables. We will begin with the potato, because that is the most important of all of them.

II. THE POTATO

1. The Eyes.—Show a potato, and call attention to the eyes.

You say these eyes are buds, but what do you mean by buds? Buds are the young shoots which grow out from a plant in the spring.

Where do you see most buds? On the trees.

What do those buds look like at first? They are **little, green, pointed knobs**, pricking through the branches of the tree.

What becomes of them? They grow bigger and bigger, and at last form new twigs and leaves.

If the lesson were given in the spring, the children would be easily able, by examining the potato, to find out these little growing shoots for themselves, and so to prove that the eyes are buds.

The teacher should then be prepared with two or three potatoes, in which the eyes have actually grown out into shoots a few inches in length. This may be easily arranged for by putting a few of the earliest sorts into a warm, dark cupboard.

Let these growing specimens be handed round the class carefully, as the shoots themselves are extremely brittle.

These potatoes you see are actually growing already. The eyes have grown out into these long, slender shoots, and at the end of each shoot there is a little curled up leaf. This is **the bud** still growing.

Plants, you know, are like children ; they cannot grow without food.

How do all plants get the food they want ? They get it from the soil in which they grow.

These young shoots have grown out from the potato ; they would in time become real plants. But I don't think they have been able to get much food where they have been, for I have had them shut up in a dark cupboard. How can they have got food to make them grow ?

Lead the children to think about the corn-grains, and the food-store laid up in them to feed the growing germ, till it is strong enough to seek its own food from the soil. Deduce from this that the substance of the potato is a similar food-store, designed to feed the young plants which grow out from the eyes.

2. How the Potato is grown.—This part of the lesson will necessarily be treated differently for town children and those living in the country. In the one case the teacher will tell and describe, in the other she will deduce from the children's own experience.

From what we have already seen it will not surprise you to learn that potato plants are grown from the old potatoes themselves, and not from seeds, like most other plants.

Each potato contains many eyes, and from every eye a new plant will spring if it is put into the ground.

Explain that plants, like animals, require room if they are to grow up healthy and strong. They must have root-room in the soil, and breathing space above ground. They cannot grow if they are crowded up.

The gardener usually selects some of the best potatoes he can find, and cuts them up into large pieces, taking

care to leave **one or two eyes** in each piece. He spreads these cuttings out in the sun to allow them to dry. The moisture from the cut surfaces dries and hardens into a sort of gum, which **closes up the pores**.

The cuttings are then ready for planting. He plants them in rows about **2 feet apart**, and at a distance of **12 or 14 inches** from each other, in ground which has been well dug and prepared.

Tell that the potato is a very delicate plant, and will not stand the frosts of early spring.

The usual time for planting is from the middle of April to the middle of May, but much depends upon the season. Some of the earliest sorts are planted before this, but they have to be protected from the frost with matting and litter as soon as they show above the ground.

In a short time **the eyes begin to sprout**. One part of the shoot makes its way upward towards the light and air, and forms **stems, leaves, and flowers**; the other part stretches downward through the ground in a sort of **underground stem, with stringy roots spreading out here and there**.

Tell that if the old cuttings could be seen then, they would be found quite dried up and shrivelled. Why is this?

When the plants are about a foot high, the gardener draws the earth up in a ridge close round their roots, to give them extra nourishment and support, and they need no more care, till the stems die down and the crop is ready for harvest.

Show the picture of the growing plant. Point out the tubers, and distinguish them from the real roots.

Explain that the main crop is ready about the end of October, and the tubers are usually raised with a fork, and stored away for the winter out of reach of the frost. New, or early potatoes are fit to dig at the commencement of the summer.

3. Potatoes as Food. Prepare a potato and rub it into a piece of muslin. Tie the pulpy mass up in the muslin, and knead it in a basin of water, calling upon the children to note what takes place. Ask whether they have seen anything like

this before, and lead them to tell the result when the piece of dough was similarly kneaded.

We got starch then from the flour, we get starch now from the potato. The greater part of the solid substance of the potato is starch. Starch is good for food.

Lesson XXVII

THE CABBAGE

Provide a cabbage, some Brussels sprouts, a red cabbage, and a cauliflower, and pictures of the growing plants.

I. INTRODUCTION

Show a good specimen cabbage, and also a picture of the growing plant. Let the children say what it is, and lead them, step by step, to tell all they remember of this vegetable from their earlier lesson.

Which part of the cabbage plant provides us with vegetable food? The leaves.

What kind of leaves are they? They are large, broad, pale-green leaves.

I will strip off one of the leaves, so that you may take it in your hands and examine it. How does it feel? It feels very smooth.

Suppose we strip off some more of the leaves one by one. What do you notice as I do it? The leaves are folded closely one over the other. The cabbage is really like a hard ball made of leaves.

What else do you see? The leaves in the middle are white, not green like those on the outside.

Why is this? The leaves are white because no light can get to them, shut up in the middle of the ball.

Do you remember another vegetable that turns white through being shut up away from the light? Celery is made white by having the earth heaped up round it, so that no light can get to it.

II. SEVERAL KINDS OF CABBAGE

Tell that the cabbage we have been examining is the common white cabbage, which lasts from the middle of spring to the end of summer. But there are several other kinds of cabbages, and they come into season (are fit for food) at different times. When one kind is over another is ready, and so we are able to get cabbage of some sort all through the year.

Explain why this is such a good thing for every one. These green vegetables are the very best food to keep our blood pure. We could not be well and healthy very long without them.

This will be sufficient to lead up to a simple enumeration of a few of the cabbage family as follows:—

1. Brussels Sprouts.—You all remember this plant (showing the picture of the Brussels sprouts). It is the Brussels sprouts plant.

Come and show me the parts of this plant which we eat. What would you call all these little green balls? They are tiny little cabbages growing out from the stem.

2. Savoy Cabbage.—Show the picture of the savoy. Point out its wrinkled leaves, so different from the smooth leaves of the summer cabbage. Tell that this is ready for cutting in the middle of winter, when there is very little green vegetable to be had. Deduce that it must be a very hardy plant to stand the winter frosts.

Explain that this cabbage is never at its best till the frost comes. The cold which would nip most plants seems to do this one good. It is a very useful cabbage.

3. The Red Cabbage.—If a specimen can be obtained it would be well to give one at hand for the children to examine, as this variety is much less familiar than the rest. Point out that it resembles the white cabbage rather than the savoy, its leaves being very smooth in texture. It is very close and compact. Cut it, and show that the leaves are full of dark red sap. Tell that this cabbage is only used for pickling.

4. Curly Kale.—Show the picture. This is a curious kind of cabbage. Instead of being folded up close and

hard like a ball, it consists of bunches or heads of curly,



CAULIFLOWER.

wrinkled leaves, which are sometimes dark green, but more often purple in colour.

5. The Cauliflower.—*Show the picture of the growing plant, and an actual specimen if it can be obtained. Let the children tell its name. Explain that this is another of the cabbage family, and proceed to examine it as follows:—*



but what is this close, white, rounded mass in the midst of the leaves?

- Here in the picture we can see the different parts of the plant—root, stem, and leaves;

Tell that this is the cluster of partly-formed flower-buds. In this case we eat not only the leaves, but the flower of the plant. They are very tender and delicious when they are boiled.

The Broccoli is a hardier kind of cauliflower, which stands in the ground through the winter, and forms its head of flower in the following spring.

One kind is known as sprouting broccoli, because while it is growing the head of the plant is nipped off, and this causes a great many sprouts of leaves and flower-buds to shoot out from the joints in the stem.

Tell that this is a very useful vegetable, as it comes at a time when most green food is scarce.

III. TURNIP-TOPS

Show the picture of the growing turnip.

I want you next to think about this plant. Which part of the plant do we use for food in this case? The root.

What kind of root do we call it? We call it a **fleshy root**.

Are all roots like this? No; most roots consist of long strings or fibres. We call them **fibrous roots**.

Why should some plants have fleshy roots like the turnip? Plants which have fleshy roots are **meant to live through the winter**. They do not die like other plants, but **shoot up again the next spring**.

How is it that they are able to do this? The solid, fleshy root contains a store of food to feed the plant when it cannot get any food from the frozen soil.

Explain that the green stems and leaves of such plants wither and die down to the ground like others when the winter comes; but the germ of the plant in the middle of the root remains alive. The food store in the root keeps the germ alive, and makes it grow again as soon as the frost is all gone.

Now let us think of the turnips in the field. As the

winter comes on the green stems and leaves die down to the ground; but in the early spring **fresh shoots begin to sproat up** from the germ, and form an abundance of tender green leaves. These provide us with a very wholesome vegetable—**turnip-tops**—which come at a time when it is difficult to get green food, and are therefore very welcome, especially in our large towns.

Lesson XXVIII

PEAS AND BEANS

Articles for illustration: some dry peas, whole and split, pea-meal, gray peas, a few germinating peas, some Windsor, French, and kidney beans, and pictures of the growing plants.

I. INTRODUCTION

The season of the year when the lesson is to be given will decide the question as to the best way of introducing the subject. Thus, in the summer-time when peas are plentiful, the teacher would naturally show a few of the green pods, and make them the starting-point. Later on, when these can no longer be obtained, it would be equally interesting and instructive to the class to get some peas (whole and split) from the corn-chandler, and trace them back to the pod and the plant on which it grows. We will make this our starting-point here.

Show the whole peas first, and let the children tell what they are, and where they have seen them.

Here in readiness a few well-soaked specimens. Let these be handed round the class, and show the children how easily the outer skin may be removed.

Lead them to tell that the pea is really in two halves. Let them separate the two halves.

What have we done to these peas? We have split them in two.

What might we call them now? **Split peas.**

Show the specimen split peas. Elicit from the children that

mother uses these split peas to make pea-soup and pudding. She asks for split peas when she goes to the shop for them.

What are split peas then? They are peas like those on the table, but they are **split in two**, and the outside skin is taken away.

Let the children examine the specimens, and lead them to tell that they are hard, dry, and yellow. Tell that peas are sometimes ground up into a sort of flour. Some people prefer to use this pea-meal for their soup and puddings instead of the hard peas themselves.

II. DRIED PEAS AND GREEN PEAS

All these peas are yellow and hard. Do you remember seeing any peas that were not yellow, and not hard? The peas we have for dinner in the summer-time are green: we call them **green peas**. They are not hard.

Yet these on the table were green and soft like them once. They were green peas, just like these you have for dinner. Why are they now hard and yellow?

Lead the children to think of the ears of corn. They are green and soft at first, but at harvest-time the grains become hard and yellow. Why?

Refer to the lesson in the earlier stage. Elicit from the children that the green peas they are familiar with grow in pods on a plant. They are the seeds of the plant. Explain that, like the young ears of corn, they are green only because they are not ripe. If they are allowed to grow till they are quite ripe they turn hard and yellow like these.

Show some **gray** peas. Point out that these are not yellow; they are a greenish gray colour. Compare their wrinkled skin and shrivelled-up appearance with the smooth round shape of the yellow peas on the table. Explain that these were gathered before they were quite ripe, and simply left to dry. In drying they shrivelled up, and their outer skin became wrinkled as we now see it.

III. THE PEA-PLANT

Show *d* picture of the growing plant. Call special attention to the slender stem—too weak to raise itself up from the ground, so that its leaves and flowers may get plenty of air and sunshine, without which no plants can grow. To make up for the stiff, erect stems which most plants have, this one is formed to climb. Point out the delicate curling tendrils, and tell how they cling to sticks and other supports so as to enable the plant to mount higher and higher. We call it a climbing plant.

Notice the flower next, without, of course, entering into any sort of scientific details.

It is a beautiful white flower, something like a white butterfly. Indeed, it is called the butterfly-shaped flower. When the flower dies off, it leaves a small pod behind, which is at first less than half-an-inch long, but grows till it is as big as those we see in the green-grocer's shop.

Let the children point out the pods, in different stages of growth, on the picture. Lead them to tell the nature of a pod—it is the seed-vessel of the plant. These pods, like all others, contain the seeds. Those seeds are the peas which we eat.

The pod consists of two parts, and can be easily split open. Next time you see one open it very carefully, not



in the rough, quick way in which you do it when you help mother to shell the peas, but by splitting it along both edges. You will then find that **each half of the pod bears a row of seeds or peas along one of its edges.** Then if you shut up the pod again, you will see that the row of seeds on one side fit in exactly between the row on the other.

N.B.—*The teacher would, of course, take the first opportunity of showing this herself; or perhaps the lesson could be timed for recapitulation in the summer when there are plenty of pods to be had.*

IV. HOW THE SEEDS GROW

Hand some peas round the class, and lead the children to point out the hilum or scar. Remind them of the similar scar in the grain of corn, and they will readily tell all about this one. It covers the germ—the tiny pea-plant which is there waiting to grow.

Have ready at hand a few germinating peas in various stages of growth.

This may be done by wrapping the seeds at different times in a piece of flannel, and standing them in a saucer of water in a warm place.

Show them now, and call upon the children to tell what has been going on. The seed itself has supplied the food to enable the tiny plants to grow. There is just sufficient food laid up to feed the little plant till its roots are strong enough to seek food from the soil.

It would be well to have a few seedlings in a box or in pots, showing further stages of development. They might then be lifted from the soil and examined.

We have been talking about the food laid up in these seeds, and now I want you to think about the corn, and the flour which we get from it.

What did we find in the water when we washed the flour in the muslin bag? Starch.

What was left in the bag? Gluten.

Tell that the pea-flour also contains starch and a substance very like the gluten of wheaten flour. This is why peas are good to eat.

V. BEANS

Show some specimens of the common well-known beans, e.g. the scarlet, the French, and the broad or Windsor varieties.

Refer the children to their earlier lesson, and lead them to tell that these are seeds too, and grow in pods like peas.

Remind them that we cook and eat the pods of the scarlet and French bean whole as they are; but we use only the seeds of the broad bean.

Tell that these seeds all contain the same two substances as peas, and that is why they are good for food.

Show some haricot beans. Tell that these are the dried seeds of a kind of French bean. We use them in stews and soups.

Show pictures of the growing plant in each case. Point out the feature of the stem in the scarlet runner. It is weak and must have a support of some kind. It gets its support by twining or twisting itself round a stick. We call it a twining plant. The Windsor bean has a stout, erect stem.

Lesson XXIX

FOREIGN FRUITS

The teacher will require two or three oranges and lemons, some candied peel, a pot of marmalade, some raisins, currants, and grapes, and a picture of the orange-tree.

I. INTRODUCTION

COMMENCE by calling upon the children to name the common English fruits as they were given in the lesson in the earlier stage. Lead them to tell that these fruits ripen one after another during the summer, and that by the time winter comes they are

all gone except one—the apple. This is a hard, dry fruit, and will keep longer than the softer and more juicy ones. Apples last till apples come again; we may see apples in the shops all through the year.

Now I want you to think about the fruiteers' shops as we see them at Christmas time. What is the name of that delicious fruit which is then more plentiful than any other? The **orange**.

There is another fruit something like it. What is that called? The **lemon**.

Then if we turn away from the fruit shop, and look in at the grocer's window, we see some other fruit. Who knows what I mean? **Plums and currants**.

What does mother do with the plums and currants? She makes the **Christmas pudding** with them.

Explain that these fruits are very welcome to us in the winter-time when all other fruits are gone. Tell that oranges and lemons, as well as the grocer's plums and currants, are brought to us in ships from the warm lands where they grow. They **would not grow in our country**. That is why we call them **foreign fruits**. They become ripe and fit to eat at the very best time, when we have very little other fruit. We are now going to learn something about them.

II. ORANGES AND LEMONS

Show specimens of both fruits. Let the children examine and compare them and so lead them to notice, one by one, the points in which the two are like and unlike each other. Have these points of resemblance and difference set out on the blackboard as they are given.

1. Points in which they are alike.—Call attention to the thick, tough, outer rind which forms the covering of both fruits. Remove the rind from each of them, and compare the outside with the inside. In both cases the outside is rough and firm to the touch, the inside smooth and fleshy. The outside too is yellow, the inside white in each case.

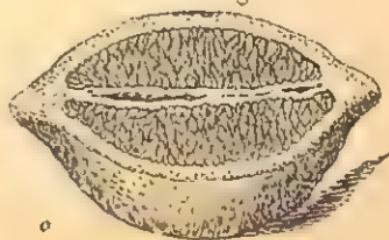
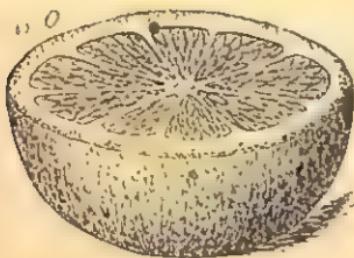
Hand a few pieces of the orange and lemon peel round the class, and let the children taste them. Lead them to tell that although the taste is not exactly the same, both have a very strong, biting flavour, and a pleasant smell.

Proceed next to examine the peeled fruit itself. Divide up the orange into its separate parts, and call attention to the peculiar shape of the three-sided, wedge-like pieces. Show how they fit together to form the rounded ball of the orange.

Notice that each one is covered with a thin but rather tough skin. Remove this skin, and show the rich, juicy pulp inside. Point out the seeds near the thin, inner side of the wedge. Take them out and have them examined. We usually call them orange pips.

Compare the lemon with the orange, and show that it is formed on exactly the same plan. In all these points the orange and lemon are alike.

2. Points in which they are not alike.—Hold up



two other specimens, and ask the class to say what difference they can see between the orange and the lemon. They are not alike in shape. The orange is round, almost like a ball; the lemon is more like an egg in shape; except that it has a lengthened nipple-like end.

We said just now that the orange and the lemon were both yellow; but are they exactly alike in colour? No; the orange is a bright reddish yellow; the lemon is a pale yellow.

Hand pieces of the orange and lemon round the class for the children to taste, and call upon them to tell the difference. Both

are juicy fruits, but the orange is much sweeter than the lemon. The lemon is so sour and sharp that it makes them screw up their faces.

3. Uses.—Lead the children to give these as far as they can, assisting them of course where necessary. None but the simplest uses need be touched upon at this stage. Oranges are not cooked; they are eaten raw; lemons are mostly used for flavouring other food. Show some candied peel, and lead the children to tell what it is, and how it is used. Explain the preparation in a simple way. Tell that marmalade is a sort of jam made from oranges.

4. How these fruits grow.—Oranges and lemons are the fruit of trees which grow only in the warm countries of the world.

Show pictures of the trees.

They are very much alike, although the orange-tree is larger and taller than the lemon-tree. It grows from 12 to 18 feet in height; the lemon-tree is only about 8 feet high. Both are beautiful evergreens, with long, oval leaves. The leaves of the orange are dark green, those of the lemon are much paler.

Both trees bear clusters of beautiful sweet-scented flowers, and when the flower dies off it leaves the fruit behind. The fruit is small and green at first, but it changes colour as it grows and ripens. A single tree often bears more than 20,000 oranges in the season.

III. PLUMS AND CURRENTS

Show specimens of both.

These are the plums and currants which we buy from the grocer to make the Christmas pudding. Let us examine them, and see what we can learn about them.

Take the plums first. Cut them open, and point out that the inside of this fruit is not like the inside of a plum. Lead the children to tell that when we open a plum we always find a big, hard stone in the middle. We call plums stone-fruit. There is no such stone in these plums which come from the

grocer's shop. Ask them to examine the inside of their plums a little more closely and see what they can find.

What are these little pips which you have found? They are the seeds.

I have some other fruit in this saucer. Do you know what they are? They are grapes.

You shall take some of these grapes and cut them open, as I did the plums just now. What do you find inside the grapes? Little pips just like those in the plums.

Tell that these plums, which the grocer sells, are really grapes, and grow on a grape-vine like all other grapes. They have another name—raisins—and this is a much better one than plums, because the word raisin means grape.

Show the currants now, and tell that these are also grapes. They are not the currants which grow on our currant bushes in the summer-time.

They were first called Corinth grapes, because they were grown at a place called Corinth, and this name has been curiously changed into currants.

Notice that these plums and currants are not like the grapes in the saucer.

Lead the children to tell that the grapes would soon go bad. Like all other juicy fruit they would not keep very long. But these raisins and currants would keep for a long time. Why is this?

Explain that it is the watery juice in the grapes which would make them go bad. There is none of that in the raisins and currants. We call them dried fruits, because after these fruits ripen they are dried in the sun. The heat of the sun dries up all the watery part of the juice. If time permit tell how this is done.

When the bunches of grapes are quite ripe they are cut from the vines, dipped into a hot liquor made of wood ashes, oil, and lime, and then spread out on wicker-work trays in the open air. The sun is very powerful in those hot countries where they grow, but it takes fourteen or fifteen days for the fruit to get quite dry. It is then packed in boxes and sent by ship to this country. The new fruit always reaches us just in time for Christmas.

Lesson XXX

HONEY AND THE BEE.

Provide some honey, and a specimen of the honey-comb, and pictures of the queen, worker, and drone, sketches of the bee's sting and tongue, a bee entering a flower, and the bee-hive.

I. INTRODUCTION

Show the specimen of honey, and proceed at once to introduce the new lesson by eliciting from the class the leading facts of the teaching in the earlier stage. This honey came from the flowers—the bees collected it, and stored it away in their hive. In the hive they make cells of wax to hold the honey which they gather. The wall of cells is called the honeycomb. The bees collect pollen from the flowers, as well as honey, and store it in the cells to feed their young. We call it bee-bread. Why do the bees store up honey in the hive?

Turn next to the bee itself. It is an insect. What does that mean? How many legs has it? How many wings? Have all insects six legs and two pairs of wings?

The teacher should carefully avoid telling anything herself, except where the children fail; and after refreshing their memory in this way point by point, she would proceed with the lesson as follows:—

II. KINDS OF BEES

Remind the children that we often speak of the bees as busy bees. Why? Because they work so hard. Tell that all the bees in the hive are not busy bees; they do not all work.

There are three kinds of bees in the hive—the workers, the queen-bee, and the drones. Show pictures of these.

1. The Workers.—These are the real busy bees, for they do all the work. They make the wax, and build the cells with it; they gather honey and pollen from

the flowers, and store both away in the cells; and they nurse and feed the young ones. The workers are the smallest of the three kinds.

2. The Queen.—There is one queen in every hive. She is the mother of all the rest, and they pay her great respect. She does no work, and she never leaves the hive, for she cannot fly far.

Compare the queen-bee with the worker in the picture. Notice that not only is her body much larger, but her wings are much shorter than those of the working bee. This will explain why she stays at home.

The queen, as the mother of all the rest, lays eggs from



time to time. She sometimes lays several hundred eggs in one day. Some of the cells in the comb are always set apart as nests to receive the queen's eggs, and she lays one egg in each cell. When the young ones are hatched they begin life in this little nest.

3. The Drones.—These are the male bees. They are much bigger than the workers, but they do no work themselves. There are very few drones in the hive. A well-stocked hive usually contains from 15,000 to 20,000 working bees, but there are seldom more than a few hundred drones. They spend a roving sort of life all through the summer, living on the honey which they sip from the flowers, but doing nothing for the general good.

Remind the children that these drones are like some idle,

useless people, who want to live on the work of others, and are too lazy to work for themselves. We often call people of this kind **lazy drones**. Tell that the workers—the busy bees—seem to object to have these idle drones living amongst them. They drive them away and kill them, even in the summer-time; but when the autumn comes, and the flowers are all gone, they set upon those that are left in a body and **sting them to death**. They make sure they will have no idle drones in their hive to live all the winter on what they have stored up by their hard work during the summer.

It is a curious thing that **only the workers have stings**; the drone has no sting—it cannot defend itself. The sting is placed at the end of the body, and consists of a pair of sharp, barbed darts, which fit into a sheath when not in use. They are **hollow tubes**, and are supplied with **poison** from a **poison bag** near their root. Bees, wasps, and hornets all have stings of this kind. When they sting, not only does the sharp point pierce the flesh, but **poison flows out into the wound** from these hollow tubes. It is the poison that does the mischief.

III. THE BUSY BEES AT WORK

1. Their work in the hive.—The first work which the bees have to do in their new hive is to build the cells. They make them of wax, and they prepare the wax itself from the food which they have eaten. When they have eaten their fill, **they hang themselves up from the roof of the hive**, and there remain for a long time. While they hang there the wax squeezes out through **six little pockets** on the under side of the body, and then they knead it up with their teeth and jaws, till it is fit for the work of cell-building.

It would be well to show all this in a picture if possible. Call attention to the little pockets or slits between the joints in the body, with the wax squeezing out from them, as the bees hang there.

Lead the children to describe the comb itself and its six-

sided cells, and show them with such an arrangement the greatest possible number of cells can be built close together without wasting the wax or losing space.

2. Their work outside.

(a) **Gathering the honey.**—The honey is collected from the flowers by means of the tongue, which is fitted in a wonderful way for its work. It is very long, and is covered with hairs like a brush. The bee can push this long tongue down to the very bottom of the flower, and lick out all the sweet juice that is there. It swallows this juice, which goes into a sort of stomach called the honey bag. When this bag is full the worker returns to the hive, and squeezes it all out into one of the cells of the comb, carefully sealing the mouth of the cell up with wax as soon as it is filled with honey.

(b) **Gathering pollen for bee-bread.**—Remind the children of the other substance—pollen—which the bees carry home to the hive. Have ready to hand, if possible, one or two well-developed flowers for inspection. Point out where the pollen is stored, in the anthers, at the top of the slender stamens of the flower. Let the children touch one of the anthers with their finger, and they will find some of the powdery dust sticking to it.

Show that when the bee enters the flower to get to the sweet nectar at the bottom of the flower-cup, it must push aside these anthers and shake out the yellow dust from them. The bee's body soon becomes as dusty as a miller, for it gets covered all over with this pollen.

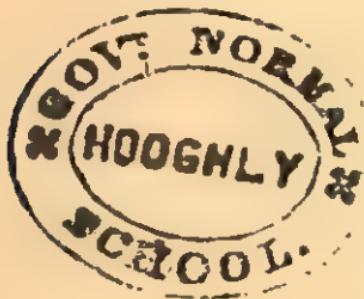
Proceed next to examine the structure of the bee, and show how well it is fitted for collecting up this pollen, and carrying it home for the little ones.

The body itself is covered all over with short hairs. The pollen collects on this hairy body better than it would on a smooth surface.

The legs too are very hairy. The bee uses its front

legs as **brushes** to brush off the pollen from its body. But what does it do with the pollen it brushes off?

Show a picture or a drawing of the bee's third leg. Point out the hollow in the outside of the thigh, with the strong, stiff hairs standing up all round it. This is a little basket. The pollen is brushed off into these little thigh pockets or baskets, and when they are filled the bee flies away home to the hive, and stores it in the cells, mixed with honey, to make bee-bread for the young ones. The drones have no pollen baskets.



THE END



